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## Articles



## Reviews



## Notes



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# OBSERVATIONS ON THE SMALL MAMMALS OF THE SOUTHEASTERN SHORE OF HUDSON BAY

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THIS REPORT IS BASED on trips made in 1950, 1953, and 1954 to Hudson Bay and Richmond Gulf. The first, an ecological reconnaissance of the Richmond Gulf area (Edwards and Chamberlin, 1951), was financed by the American Philosophical Society; and the second, during the summer of 1953 (Edwards and Chamberlin, 1962), to investigate the hydrobiology of southeastern Hudson Bay and Richmond Gulf, was financed jointly by the American Philosophical Society, the Woods Hole Oceanographic Institution, the Geological Society of America, and the American Academy of Arts and Sciences. The research was continued in the summer and fall of 1954 with funds obtained from the Arctic Institute of North America.

Dr. J. Lockwood Chamberlin* was my partner on all of these trips. His interest was the invertebrate marine fauna and the hydrography of the area. My father, Robert D. Edwards, accompanied us on the first leg of the 1953 trip.

We made the trip to Richmond Gulf in 1950 on board the M/V *Fort Charles* through the courtesy of the Hudson's Bay Company. The 1953 and 1954 trips were made aboard our own research vessel, the R/V *Lemming*, a thirty-foot ex-shrimper.

From the viewpoint of a mammalogist, the summer of 1950 was desolate around Richmond Gulf, following as it did the die-off of the rodent population of the previous fall. We spent two weeks circumnavigating the area that season, trapping (over 900 trap-nights) wherever we stopped. Not a single microtine was seen or caught. The loneliness of the land was relieved only by the presence of a few red squirrels, a porcupine and a weasel. However, numerous skeletons of mice and large scat piles pointed to a large rodent population during the previous summer.

Although the rodents were numerous in 1953, an expected peak year of the four-year cycle, our success in collecting small mammals was less than we had hoped. The difficulties of doing hydrographic work from a small boat in Hudson Bay, under generally adverse weather conditions, severely limited our opportunities to work on land. Whenever the opportunity presented itself, we went ashore to set traps and make observations of the rodents. By standing quietly we could usually see several moving about and feeding, where in 1950 not a single microtine was to be seen or trapped.

We named our anchorages and prominent features of the landscape. It should be emphasized here that many of these names do not have any official

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sanction. Such unofficial geographic references are indicated by an asterisk when used for the first time.

Subspecific designations have not been attempted, pending further study with more extensive material than is presently available from the entire northern Quebec area. The bulk of the material has been deposited in the Museum of Comparative Zoology, Harvard University.

## AREAS INVESTIGATED

Each of the areas trapped is described briefly below. A short description of the plant life is included. For further detailed information on the plants and plant associations, the reader is referred to Marr (1948), Hustich (1951), and Dutilly and Lepage (1951).

*Merry Island* (*55°22'N, 77°45'W*). The southernmost island of the Manitounick Peninsula (see inset, Figure 1) is a tilted thrust block with the high steep face on the sound (east) side. This topography is typical of the Hudson Bay coast from here on to well north of Richmond Gulf. A canyon-like cut runs through the island a short distance north of the tip. The distinctive green aspect of this cut, with its small spruce forest, completely isolated from the mainland and from similar plant communities along the island chain, attracted our attention late in the afternoon of August 23, 1953.

The cove at the end of the cut was small with a relatively rocky beach. Above the strandline was a broad zone of the grass *Elymus arenarius*. Beyond this there was an extensive area of shrubs and forbs, including *Salix* (several species), *Juniperus*, *Betula*, *Vaccinium*, *Arctostaphylos*, several species of *Carex*, *Solidago*, *Potentilla*, and *Saxifraga*. Farther back of this where sufficient sandy soil existed, was the spruce *Picea mariana*. The ground cover in the spruce was composed to a great extent of lichens and mosses, with *Cornus canadensis*, *Ribes glandulosum*, *Linnaea borealis* and *Empetrum nigrum* in patches and individually. On the rocky talus areas a more typical tundra flourished, composed largely of many kinds of reindeer mosses, with *Vaccinium Vitis-ideae*, *Empetrum* and *Dryas integrifolia* in abundance. A substantial growth of dwarf *Betula* and *Salix* species occupied the lower parts of the talus slopes.

Twenty-five traps were put out just before dark, in a line running through all of the above-mentioned plant communities. Shortly after dark the trapline was checked and when five *Phenacomys* were found to be trapped, principally in the drier portions of the talus, ten more traps were put out in this area. The traps were removed the following morning when we departed.

**Three Islands Harbor* (*56°07'N, 76°04'W*). The trapping was done on the westernmost of three small islands that form a protected anchorage in the southeastern part of Richmond Gulf. A narrow band of *Elymus* with an admixture of *Ligusticum scothicum* bordered the strandline on the harbor side, followed by a substantial growth of alder (*Alnus arctica*), and succeeded in turn by a dense thicket of small spruce where the slope steepened. Near the top of the island, where it leveled out, a typical reindeer moss tundra, with a scattering of *Vaccinium uliginosum* and *V. Vitis-ideae*, *Epilobium*, *Ledum*, *Salix reticulata* and other dwarf willows, was followed by the bare rock top.

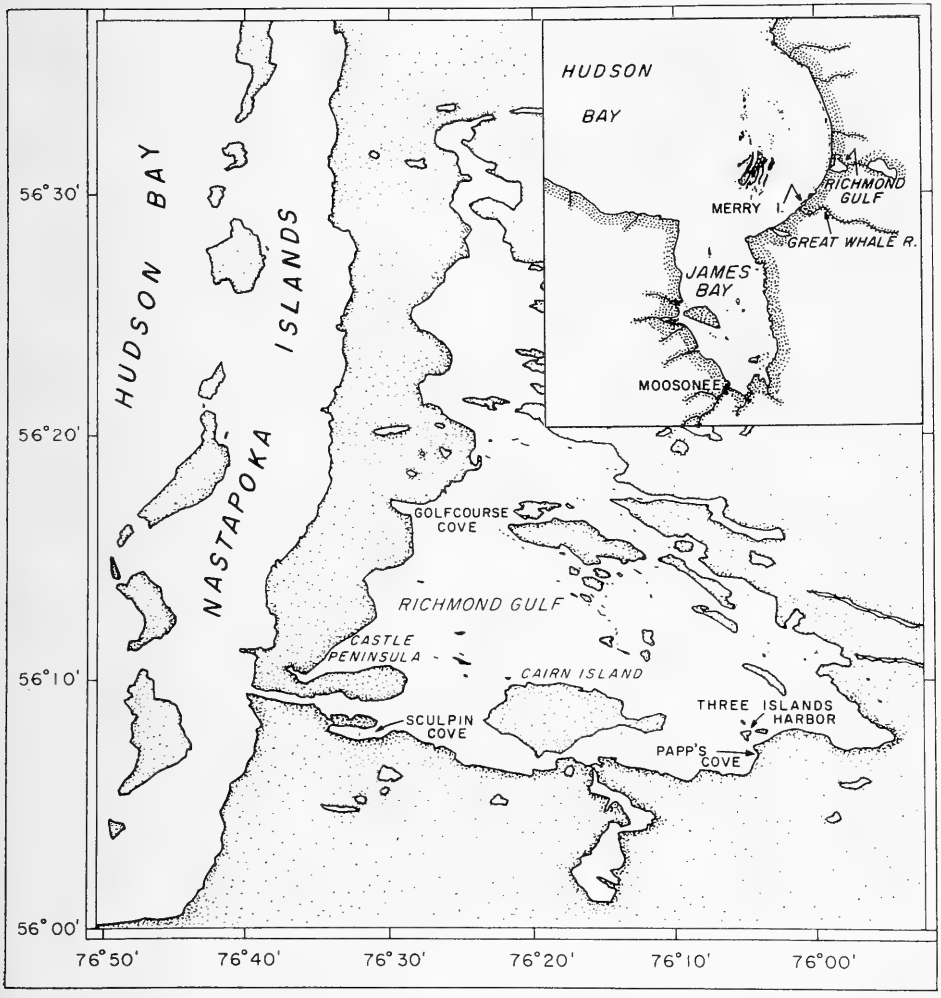



FIGURE 1. Map of Richmond Gulf area indicating localities mentioned in text.

A trapline of thirty traps was set out for two nights on the evening of August 29.

**Papp's Cove (56°06'N, 76°04'W)*. This large cove in the southeastern corner of Richmond Gulf is the site of the Hudson's Bay Company store and the Roman Catholic Mission. Until 1954, a free trader, Mr. George Papp and his wife lived there. Mr. and Mrs. Papp are well known for their many kindnesses to the various investigators who have worked in and around Richmond Gulf.

Near the trading post, at the north end of the beach, was a flat, lush, grassy area. A series of broad, poorly defined terraces extended back to bare rounded hills about a mile to the rear. The level portions of the terraces were

covered with a mixture of lichens and forbs typical of the area. The slopes of the terraces had a luxuriant growth of *Betula glandulosum* which extended a variable distance out onto the terraces below. A small creek, called Beach Creek locally, bisected the terrace series. Its steep banks were covered with alder and spruce. Where the terraces adjoined the hills, spruce was usually abundant. *Larix* and *Alnus* occurred with the spruce. Some of the common flowering plants of the area were *Solidago multiradiata*, *Rhinanthus oblongifolius*, *Epilobium latifolium*, *Aster puniceus*, *Linnaea borealis* and *Cornus canadensis*.

Thirty-five traps were put out here late in the afternoon of September 23.

**Golfcourse Cove* (*56°17'N, 76°30'W*). This was a large, well-developed raised beach series at the end of a cove on the western side of Richmond Gulf. The usual grass zone with *Lathyrus japonicus* following the beach gradually gave way to a typical lichen tundra admixed with *Arctostaphylos*. *Vaccinium uliginosum* and *V. Vitis-ideae*, *Tanacetum huronense*, *Artemisia borealis*, *Salix vestita*, and *S. arctica* occurred in patches on the level portion of the terraces. The slopes of the terraces generally had considerable *Betula glandulosum* on them. On either side of the terraces, near the cliffs with their talus, various arctic forbs abounded. A small stream ran down through this terrace series with a considerable growth of alder along its bank at the lower end. While we were here, a series of bad storms made it hazardous to row ashore from the boat. As a result, only one trapline of thirty traps was run and this on the night of September 10.

**Sculpin Cove* (*56°08'N, 76°33'W*). I trapped (300 trap nights) this area for several days during the 1950 trip but secured no mice. On September 25, 1953, ten traps were placed in a broad, dense growth of alder and willow along a small stream, while fifteen were placed in a relatively luxuriant growth of spruce. The traps were pulled early the following morning when we departed.

## ABUNDANCE

In 1950, over 600 trap nights of effort were expended in the Richmond Gulf area, without effecting the capture of a single vole or lemming. Red squirrels were observed in fair number wherever the spruce was well developed and specimens were secured without difficulty. One varying lemming was observed running across an open area in the spruce at Great Whale River. However, the evidence of a high population the previous year in the form of carcasses, skeletons, scat piles, grass cuts, and so forth, was everywhere to be observed.

In 1953, on the other hand, the voles especially abounded and were easily captured and readily observed. The captures obtained are listed in Table 1. A comparison of these data with those of Smith and Foster (1957) for the Churchill area on the other side of Hudson Bay would suggest that the small mammals on the east coast reached a higher density more quickly, both populations being at a low level in 1950 or 1951. Although I was unable to complete the 1954 trip and repeat the small mammal survey, Chamberlin (*personal communications*) reported that the small mammals were still in evidence during

TABLE 1.—Small mammal captures with snap-traps in 1953. Trap lines visited once late at night and in morning

| Species/No. trap nights | Merry Island | Three Island's Harbor | Papp's Cove | Golfcourse Cove | Sculpin Cove | Total |
|---|---|---|---|---|---|---|
| | 35 | 60 | 35 | 35 | 25 | 190 |
| *Sorex cinereus* | — | — | 2 | 1 | — | 3 |
| *Clethrionomys gapperi* | 6 | 23 | 10 | 8 | 5 | 52 |
| *Phenacomys ungava* | 9 | 15 | 9 | 4 | 5 | 42 |
| *Microtus pennsylvanicus* | 2 | 12 | 8 | 1 | 3 | 26 |
| *Synaptomys borealis* | 6 | 11 | 2 | 4 | 2 | 25 |
| *Dicrostonyx hudsonius* | 1 | 5 | — | 2 | — | 8 |
| *Peromyscus maniculatus* | 2 | — | — | — | — | 2 |
| Capture totals | 26 | 66 | 31 | 20 | 15 | 158 |

the late summer and fall. It therefore seems apparent that there is no definitive four year cycle as far as the microtines, at least, are concerned.

## PREDATORS

Foxes, *Vulpes vulpes*, were seen on Weston Island in the south central part of James Bay but nowhere else. A striking number of Short-eared Owls, *Asio flammeus*, and Rough-legged Hawks, *Buteo lagopus*, were observed. Every cliffside bordering on tundra or spruce harbored at least one pair of Rough-legged Hawks and their offspring. Short-eared Owls were frequently observed flying at dusk, particularly at Richmond Gulf, in groups of five or six. The owl pellets found contained the skulls and bones of *Phenacomys* and *Microtus*.

## SPECIES ACCOUNTS

The following annotated list includes notes on all species observed and/or collected. No effort was made to capture all possible species in the area. We attempted, within the limitations of time, to observe what we could of the voles and lemming, and to determine their relative density.

Fleas were collected and identified by the author. To avoid straggling, each mammal species was transported and kept in separate cloth bags until the specimens could be examined.

Mean measurements are given, followed by extremes in parentheses. Standard length measurements are given to the nearest millimeter. Weight is in grams.

*Condylura cristata* (Linnaeus) STAR-NOSED MOLE

A skin of the star-nosed mole was obtained from Mrs. George Papp. Her eskimo dog had caught the mole the previous year behind her house. This is the most northerly record to date, although it seems reasonable to predict that *Condylura* may eventually be collected in the Fort Chimo area.

*Sorex cinereus* Kerr COMMON CINEREOUS SHREW

Three specimens of the cinereous shrew were collected in the Richmond Gulf area, one in the *Elymus* zone at Golfcourse Cove, the other two in the alders and dwarf birch at Papp's Cove.

Average measurements of three adults (no sex) are: total length 95 (90-105); tail 40

(37-42), hind foot 11 (11-12); weight 3.5 (1 specimen).

*Mustela erminea* Linnaeus SHORT-TAILED WEASEL

An adult male weasel was collected at Papp's Cove, July 25, 1950, by Andrew, an Indian boy. It measured as follows: total length 310; tail 93; hind foot 43; testes 8; and weight 170.

Another weasel was observed the same month near a small stream where I was fishing. I had laid a sizable char behind me on the bank when the weasel appeared and attempted to make off with the fish. This, despite the fact that the fish weighed 13 pounds. The weasel retreated, squeaking angrily, when I approached.

A skull of this species was picked up in the surf at Golfcourse Cove.

*Lutra canadensis* (Schreber) OTTER

Seeing my labors stuffing mice, an old Indian brought me a peculiar specimen of mammal that he had prepared himself. It was made up like a museum study skin and stuffed with dried moss. He had trapped a female otter that April (1950) near Richmond Gulf and stuffed up one of the unborn young.

*Phoca vitulina* True HARBOR SEAL

The harbor seal was seen from time to time in Richmond Gulf, less frequently along the coast of Hudson Bay itself. It is, of course, much sought after by the Eskimos of the area for food and clothing.

*Erethizon dorsatum* (Linneaus) PORCUPINE

Porcupines were not observed often although they were in evidence in the better-developed stands of trees. One specimen was collected at Sculpin Cove in 1950, a female, measuring as follows: total length 686; tail 127; hind foot 89.

*Marmota monax* (Linnaeus) WOODCHUCK

Several skins belonging to Mrs. Papp were examined. Indians infrequently catch woodchucks in the interior behind Richmond Gulf.

*Tamiascuirus hudsonicus* (Erxleben) RED SQUIRREL

During the 1950 trip we spent several days in the Sculpin Cove area, living in what remained of the Gulf Lead Mines cabin. Red squirrels were frequently seen in the nearby spruce; it was possible to walk to within a few feet of them without their showing much fear. The squirrels spent much of their time on the ground and in burrows under and around the spruce. Middens were found infrequently and they were not especially large. We searched for but did not find any nests in the trees.

Each of the red squirrels captured carried a few fleas, *Orchopeus caedens* (Jordan) in every case.

The average measurements of two adult females are: total length 310; tail 116; hind foot 47; weight 200.

*Clethrionomys gapperi* (Vigors) GAPPER'S RED-BACKED VOLE

The red-backed vole was abundant in the spruce thickets and under the denser and wetter cover of shrubs. Considering the relative proportions of the various plant communities further inland, the red-backed must have been the most abundant small rodent in boreal Ungava during the summer of 1953 if our experience was any criterion (cf. Cameron and Morris, 1951). With the exception of *Dicrostonyx* it was the only species that went consistently for the bait. The red-back did not make any obvious runs, but a trap by any likely looking hole in the moss of the spruce groves, or in a cavity under the roots of a spruce, or under a thicket of alder, birch or *Ledum*, or down deep between rocks in a cavity in the forest would get one every time.

Our first experience with this mouse was in a Hudson's Bay Company warehouse while we were outfitting the R/V *Lemming* at Moosonee. Four were taken here and only one had the typical red-back coloration. The other three were colored much like No. 6 in Bang's plate (1897), although a bit darker. All of those collected on Merry Island were normally colored. Three of twenty from Three Islands Harbor were gray-brown. All those collected behind Papp's were typical but for one completely black specimen. Of five from the south side of the terraces at Golfcourse Cove, one was dark brown and another black, while those from the talus on the north side were all yellowish brown and so different in general appearance that it was hard to believe that they were red-backs. The speci-

mens from Sculpin Cove were all typical. Most of the normally colored red-backs at Richmond Gulf had an unusually intense yellow coloration on the belly.

There was no evidence of any current breeding activity at Spruce Canyon, Papp's Cove, or Sculpin Cove. At Three Islands Harbor, the adult females were all lactating and their uteri were swollen, although none were carrying embryos. The female red-backs at Golfcourse Cove also had internal evidence of recently completed breeding, the males all had partially enlarged testes, 4 mm on the average, that were ascending or had ascended. More immatures were collected here than anywhere else. Very few mice that could be definitely assigned to the previous season were captured.

All stomachs examined contained finely chewed green plant matter, and the contents of many were colored a dark blue presumably from the berries of *Vaccinium uliginosum*. There were considerable cut pieces of *Ledum palustre* about the haunts where red-backs were trapped at Three Islands Harbor.

Trapped specimens of red-backed mice usually carried a few fleas each of two species, *Malaraeus penicilliger dissimilis* Jordan and *Monopsyllus quirini* (Rothschild).

The average measurements of 17 adults (9 males, 8 females) are: total length 162 (150-170); tail 44 (38-47); hind foot 19 (18-20); weight 37 (23-49).

*Phenacomys ungava* Merriam HEATHER VOLE, PHENACOMYS VOLE

The heather vole was the commonest rodent in the particular areas we visited. *Microtus* was similarly abundant, but only in the restricted zone of grass above the shoreline. Many were caught in the talus, in hollows in the tundra and under the dwarf trees where no discernible pathways could be seen (Figure 2A). The majority were caught on the shallow, broad but not obvious runs that connected patches of cover or ran from the spruce forest out onto the open areas. A single nest containing an immature female was found under a large, flat rock a scant twenty feet from the water's edge at Three Island's Harbor (Figure 3). The voles were frequently observed during daylight hours storing the stems of *V. Vitisideae* in shallow burrows (old lemming burrows apparently) and under rocks in the open flat areas, cf. Foster, 1961, p. 193 (Figure 2B). These stems, from three to six inches long, were cut at the base and stored intact, leaves, stem, berries and all. There were no nests connected with these caches. It was not apparent that the voles were interested in the berries, although they were plentiful and ripe. The stomachs examined all contained finely chewed green plant material. *Aster puniceus* was common at Three Island's Harbor, and in those areas where there were many *Phenacomys* it was usually badly cut up, presumably by this species.

The voles apparently breed through the month of August. All the males caught after this time had ascending or ascended testes. One female from Merry Island had embryos, R1L3-2 mm. Several females from this locale and from Three Islands Harbor had recently given birth. The number of truly immature individuals captured seemed unusually small, despite the fact that the voles were still breeding when we first got to Hudson Bay.

Fleas, *Monopsyllus a. asio* (Baker), were found occasionally on trapped specimens.

The average measurements of 18 adults (8 males, 10 females) are: total length 143 (131-161); tail 32 (26-38); hind foot 18 (16-20); weight 40 (29-54).

*Microtus pennsylvanicus* (Ord) PENNSYLVANIA MEADOW VOLE

Excluding those taken on the islands in James Bay, all the meadow mice collected may be provisionally referred to *Microtus pennsylvanicus labradorius* Bailey. The fully adult animals tend to be large, up to 180 mm in total length and weighing as much as 76 grams. Their coloration is paler than typical *M. pennsylvanicus*, homogeneous on the sides and dorsum, belly typically pale gray. There is an obvious yellow-brown spot on either side of the muzzle.

In the summer of 1953, *Microtus* was abundant everywhere we went, especially in the grassy, wetter areas. The runs were used so frequently and by so many mice that in many places they were beaten more than an inch into sandy soils (Figure 2C). In some places, where it was estimated that the numbers exceeded two hundred individuals per acre, no nests could be found. Around the buildings at Richmond Gulf, the mice occupied every discarded can and

were to be found under almost any board, under drums of gas, in pipes, in fact under or in anything that offered protection. In those places bordering on water, where a relatively narrow strip of grass was backed up with alders, the grass zone was riddled with runs, and broader runs could be seen leading into the alders. Presumably the mice had burrows and nests amongst the shrubs, but none could be found. The mice were rare or not present within the spruce forests, nor were they taken on the tundra. They were caught, however, in a most barren talus slope at Golfcourse Cove.

Meadow vole scat piles were distinctively bright green and so constantly trodden upon that the scats were coalesced into homogeneous masses. They varied in size from small piles to masses five or six inches in diameter and an inch or so thick.

Occasional specimens of *Microtus* were caught with one or two fleas on them, of the species *Monopsyllus a. asio* (Baker).

The average measurements of 10 adults (4 males, 6 females) are: total length 175 (168-195); tail 46 (39-59); hind foot 19 (19-20); ear 16 (14-17); weight 64 (53-76).

On August 13, 1953, we anchored for the night off a small island about two acres in size. The position of the island, as best we could determine, was 53°57'N, 79°25'W. It was typical of the many small islands off the coast of northeastern James Bay, being low, not over fifteen feet high, and rounded. The island was obviously washed over by water during bad storms. There were large drift logs at the highest point. Here and there in the hollows on the island, a mossy sod had developed that supported a few species of higher plants including *Matricaria*, *Potentilla*, *Agrostis* and *Carex*. Wherever a patch of sod adjoined a pool of water, well used runs were found. Three nests were located, two barely concealed by the grass and one underneath a log. The nests were large and globular, about ten inches in diameter, and made of relatively coarse material outside with a small inner nest of finer materials.

One nest contained four approximately two-week-old *Microtus*, another, three approximately three-week-old *Microtus*, and the third, five babies estimated to be only three or four days old. When the nests were opened the older young immediately ran off, going without exception to the pools of water which they swam across with facility. When I first landed I had set out five traps. These were retrieved less than one hour later and found to contain four *Microtus*, two of which were adult females carrying embryos, R3L2-2 mm and R3L2-5 mm.

These voles were no different in coloration from those caught further north, nor did the teeth differ. With the exception of a slightly more obvious infraorbital foramen in the front view, there is nothing particularly unusual about the skulls. The ear measurement, however, was strikingly different, being two or three millimeters smaller (12-13, instead of 15-17 millimeters) than that of the mice collected further north.

*Ondatra zibethica* (Linneus) MUSKRAT

A muskrat was seen swimming in a small creek late at night on the west side of Richmond Gulf in 1950.

*Synaptomys borealis* Richardson NORTHERN BOG LEMMING

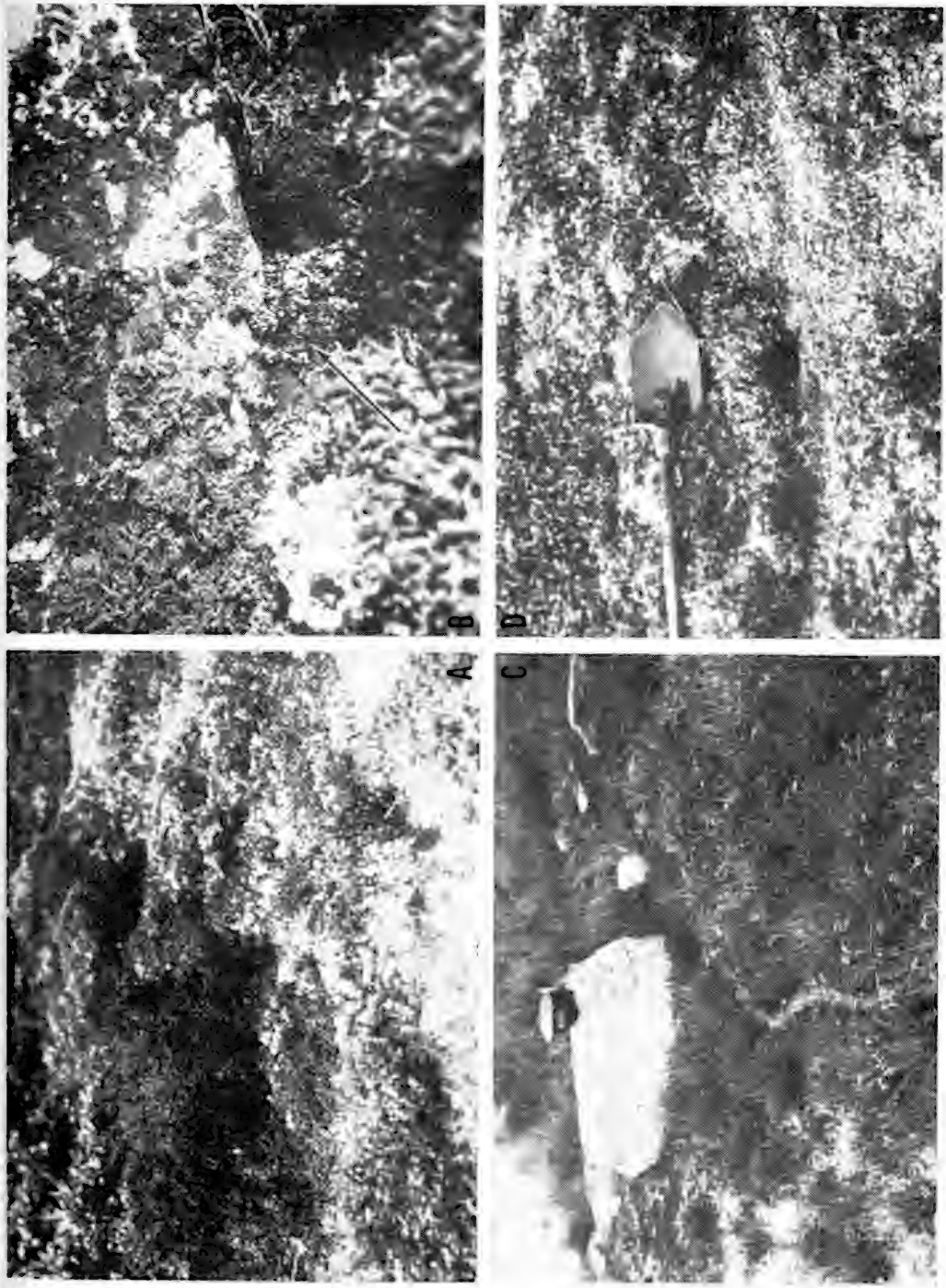
This was the least abundant of the microtines observed and captured. Within particular habitats, such as the neighborhood of water holes in the tundra, they were to be seen at any time, scurrying about on the muddy banks and chasing one another through the grass. While an occasional bog lemming was captured in the spruce or birch thickets, most were taken in the open, very wet places. They paid no attention to the

FIGURE 2A. Lichen-covered talus at Spruce Canyon where *Phenacomys* were trapped. The lack of runways, even about the entrances to burrows and cavities under boulders, is typical of those areas where *Phenacomys* abounded.

FIGURE 2B. Hole under boulder in which *Phenacomys* was storing stems of *V. Vitis-ideae*. Arrow indicates pile of stems removed.

FIGURE 2C. A typical *Microtus* run across a wet meadow. The bottom of the run itself had been beaten down almost a full inch below the original soil level.

FIGURE 2D. A typical *Dicrostonyx* burrow and its associated run on one of the beach terraces at Golfcourse Cove.


A
B
C
D

bait, being caught instead when they ran across the trap. There were no marked signs such as scat piles or grass cuttings that could be associated with this mouse.

Only two of the bog lemmings showed any signs of active breeding. One male taken on Merry Island, August 23, had fully developed and descended testes 13 mm in length. A female from Golfcourse Cove, caught September 10, carried three large embryos, R1L2-25 mm. For the most part these mice appeared to be yearlings. There were apparently two litters in the summer of 1953, the first by the adults of the previous season and a second by these adults and some of their progeny late in the season.

A very few had fleas, in every case *Monopsyllus a. asio* (Baker).

Average measurements of 19 adult specimens (8 males, 11 females) are: total length 133 (120-152); tail 20 (17-23); hind foot 18.5 (17-20); weight 31 (23-42).

*Dicrostonyx hudsonius* (Pallas) LABRADOR VARYING LEMMING

It was most surprising that only seven varying lemmings were obtained by trapping. They were not common, and few were seen abroad. Several were observed traveling along runs through thickets of willow and birch at Little Whale River and one running across the tundra at Golfcourse Cove. All that were trapped were caught below the surface of the ground beneath spruce roots, in rock crevices, or in large cavities near the water holes on open areas.

Distinctive varying lemming burrows (Figure 2D) were relatively common on the terraces at Richmond Gulf and many were excavated to determine their structure, to obtain lemmings, and to examine the nests for fleas. Their burrows are quite simple as can be seen from the diagrams of Figure 3. The typical occupied burrow had a small pile of fresh dirt at the entrance. A short length of tunnel, eighteen to twenty inches, led downward to a round, somewhat flattened nest of fine grass. The nest was not obviously differentiated into an outer and inner portion. There was usually a scat pile beneath the nest. If the burrow was branched, the branch was seldom currently used for any purpose and partially filled with moldy scats. Most burrows continued behind the nest for considerable distances. If the burrow was occupied, the lemming was always found at the extreme end attempting to dig out of danger. However, even in easily excavated sandy soil they appeared to make little headway, which may explain the simplicity of their burrows. The burrows that we observed had entrances either at the base of a dwarf willow or birch or at the foot of the beach terraces. Lemming pathways typically ran from clump to clump of shrubs and along the foot of the terraces. Each lemming apparently maintained a two- or three-burrow system inasmuch as only one animal was ever found in any one series of burrows obviously connected by runs. It would appear that the relationship between the lemmings and the other microtines was much the same as that of the woodchuck and the rabbit in northeastern United States. Many burrows examined at Richmond Gulf appeared to have been originally constructed by a lemming, whatever the rodent species occupying them at the time.

Lemming scat piles did not have the appearance of *Microtus* or *Phenacomys* piles inasmuch as the individual scats more or less remained separate. Some scat piles easily exceeded a foot in diameter and a height of six or more inches.

All of the lemmings captured alive died within a day or two. They usually lapsed into a rigor similar to that seen in *Zapus* after they have been caught by the tail or the foot on a cold and/or wet night. While it may have been symptomatic of an approaching cyclic die-off, this does not seem likely inasmuch as we found no dead lemmings while we were in the area.

No evidence of breeding was observed.

Both lemmings and their nests were remarkably free of ectoparasites. Only a very few fleas, *Monopsyllus a. asio* (Baker), were found in the nests. The specimens from Three Islands Harbor carried a few *Monopsyllus quirini* (Rothschild) and *Malareus p. dissimilis* Jordan.

Average measurements of 8 adults (5 males, 3 females) are: total length 143 (135-152); tail 16 (15-17); hind foot 20 (18-21); weight 66 (55-85).

*Peromyscus maniculatus* (Wagner) WHITE-FOOTED MOUSE

Two immature specimens of white-footed mice were collected on Merry Island. These were the only specimens secured. Cameron

and Morris (1951) found this mouse to be the second most abundant in the Lake Mistassini and Lake Albanel area inland and to the south. It would seem that the white-footed mouse tends to avoid the forest-tundra community typical of the areas we visited.

*Zapus hudsonius* (Zimmerman) HUDSON BAY JUMPING MOUSE

Two specimens of the Hudson Bay jumping mouse were caught at Moose Factory, July 29, 1950, at the point where a field bordered spruce forest. An adult male

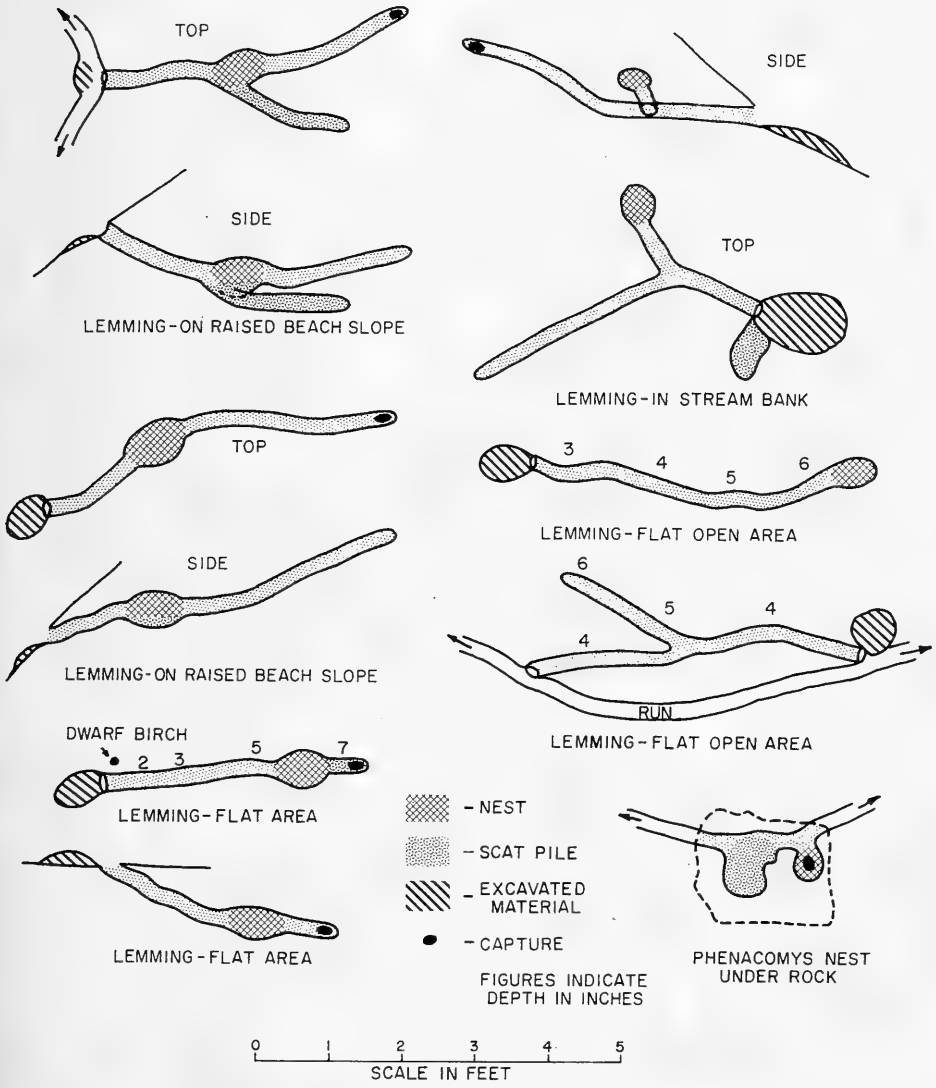



FIGURE 3. Burrows of varying lemmings and heather vole.

measured as follows: total length 205; tail 114; hind foot 32; weight 18.

*Delphinapterus leucas* (Pallas) BELUGA

The beluga was frequently observed from James Bay northward. This porpoise was not seen within Richmond Gulf. However, Chamberlin reports that one beluga closely circled the R/V *Lemming* while at anchor in southeastern James Bay, late in the summer of 1954.

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## A CANADIAN RESEARCH DIRECTORY

The Canadian Society of Wildlife and Fishery Biologists has produced a directory of current research in Canada in wildlife and fishery biology. Projects are listed by Province, agency, title and leader with probable date of completion. The directory contains some 705 entries which are fully indexed and cross-indexed. It is mimeographed and in ring binding so that new material can be added. Present plans are to revise the directory every two years. The directory is free to members of the Canadian Society or can be purchased for $3.00 from the Secretary-Treasurer, C.S.W.F.B., Box 2292, Postal Station "D", Ottawa, Ontario.

# THE COMPARATIVE NUMBER OF SPECIES OF AMPHIBIANS IN CANADA AND OTHER COUNTRIES

## III. SUMMARY OF SPECIES OF ANURANS

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This paper is the third and final part of the Comparative Number of Species of Amphibians in Canada and other Countries. It deals with the Anurans, order Salientia, tailless amphibia – the frogs, toads and treefrogs. As in Part II an attempt has been made to include the names of all valid species up to the year 1957. Subspecies and synonymous names have not been included. If the species contains two or more subspecies the number is marked following the specific name, ex: (2r). This would include the nominate plus one other race.

Boulenger (1882) revised all the genera and species of Salientia known at the time. Nieden (1923, 1926) and Ahl (1931) covered most of the world Salientia, with the exception of the family Ranidae. Parker (1934) monographed the family Microhylidae. Boulenger (1920) monographed the Asian *Rana*. There is no recent checklist for South America. Günther (1900-1902) treated the species known from Central America. Mertens and Müller (1940) and Mertens and Wermuth (1960) are the basic checklists for Europe. The checklist for North America is Schmidt (1953). There is no recent work covering all the Salientia of Asia. Moore (1961) listed all the species known from Australia. Noble (1924) is the last checklist for Africa, but this work did not include Madagascar. Loveridge (1957) covers a large area in East Africa.

The work of Gadow (1901), Noble (1931) and Cochran (1961) contain valuable information on the Order Salientia (frogs and toads) in general.

Das Tierreich, a work of the German Zoological Society (Walter de Gruyter, publisher) has been revived, and a series of checklists covering the entire Class Amphibia is planned. Vol. 78, Gymnophiona (a checklist of the caecilians of the world) has recently been published.

A checklist of the Hylidae of the world is in preparation by Mr. John Condit and he has kindly sent me a manuscript copy.

The Zoological Record is the best single source of information and I have checked all the records (Amphibia and Reptilia section) up to the year 1957.

I wish to thank Mr. Francis Cook, Curator of Herpetology, National Museum of Canada and Dr. Sherman Bleakney, Acadia University, for reading the manuscript.

The approximate number of species for each country has been compiled by consulting the literature up to the end of 1957 and where possible reference to the basic checklist or catalogue is given.

SOUTH AMERICA

Argentina 80, Cei (1956); Brazil 265, Miranda Ribeiro (1926) and Cochran (1955); British Guiana 60?, Crawford (1931) and Parker (1935); British Honduras 15, Schmidt (1941); Chile 27, Capurro (1958); Colombia 130, Dunn (1944); Costa Rica 125, Taylor (1952); Cuba 28, Dalmau (1955); Ecuador 175, Peters (1954-55); El Salvador 20, Mertens (1952); Guatemala 50; Hispaniola 31, Cochran (1941); Honduras 20, Dunn and Emlen (1932); Jamaica 20, Lynn and Grant (1940); Mexico 175, Smith and Taylor (1948); Nicaragua 40; Panama 90; Paraguay 40; Peru 80; Puerto Rico 15, Schmidt (1928); Trinidad 25, Parker (1933); Uruguay 40; Venezuela 80, Gines (1959); West Indies 105, Barbour (1937).

NORTH AMERICA

Canada 20, Logier and Toner (1961); U.S.A. 64, Schmidt (1953).

EUROPE

Europe 22, Mertens and Wermuth (1960); U.S.S.R. (European) 15, Terentjev and Tschernov (1949).

ASIA

Afghanistan 3, Leviton (1959); Borneo 95, vanKampen (1923); Burma 50; Celebes 30, vanKampen (1923); Ceylon 33, Kirtisinghe (1957); China 95, Pope and Boring (1940); Fiji Islands 2, Barbour (1923) and Brown and Myers (1949); Formosa 23; French Indo-China (Vietnam, Cambodia, Laos) 95, Bourret (1942); India 200?, Boulenger (1890); Iran 9; Iraq 4, Allouse (1955); Israel 6, Mendelssohn and Steinitz (1944); Japan 25, Okada (1931) and Takashima (1955); Java 40, vanKampen (1923); Jordon 5; Korea 10, Shannon (1956); Malaya 90, Boulenger (1912) and Smith (1930); Mongolia 4, Bannikov (1958); New Guinea 120, Loveridge (1948); Pakistan 50?; Philippine Islands 58, Inger (1954); Ryukyu Islands 25, Inger (1947); Saudi Arabia 6; Solomon Islands 17; Brown (1952); Sumatra 65, vanKampen (1923); Syria 7; Thailand 70, Taylor and Elbel (1958); Turkey 10, Bodenheimer (1944); U.S.S.R. (Asiatic) 11, Terentjev and Tschernov (1949).

AUSTRALIA

Australia 90, Loveridge (1935), Parker (1940), Copland (1957) and Moore (1961); New Zealand 3, Stephenson and Stephenson (1957).

AFRICA

Algeria 3; Angola 85, Monard (1937); Bechuanaland 25?; Belgian Congo 120, deWitte (1934); British Somaliland 14?; Dahomey 39?; Egypt 4, Flower (1933); Eritrea 12, Scortecci (1929); Ethiopia 40, Scortecci (1933); French Equatorial Africa 100?; French Guinea 30?; French West Africa ?, Chabanaud (1921); Ghana 35; Ivory Coast 40, Loveridge (1955); Kenya 55, Loveridge (1957); Liberia 50, Barbour and Loveridge (1930) and Taylor and Weyer (1958); Libya 5?, Scortecci (1936); Madagascar 130, Mocquard (1909); Morocco 5,

Werner (1929); Mozambique 30, Parker (1930) and Manacas (1950); Nigeria 45; Nyasaland 40, Loveridge (1957); Portuguese Guinea 20, Manacas (1949); Rhodesia 70?, Pitman (1934); Sahara 10?, Angel (1944); Senegal 20?; Seychelles 5, Parker (1936); Sierra Leone 15; Somaliland (Italian) 24, Scortecci (1933); South Africa 85, FitzSimons (1947) and Inger (1959); Southwest Africa 25, Mertens (1955); Spanish West Africa ?; Sudan 40?; Tanganyika 100, Loveridge (1957); Tunisia 3; Uganda 40, Loveridge (1957).

SALIENTIA (FROGS)

**South America**
(including Central America and Mexico)

PIPIDAE

*Pipa* Laurenti 1768: *aspera* Müller 1924; *carvalhoi* (Miranda Ribeiro) 1937; *parva* Ruthven and Gaige 1923; *pipa* (Linnaeus) 1758; *snethlageae* Müller 1914.

PELOBATIDAE

*Scaphiopus* Holbrook 1836: *couchi* Baird 1854; *hammondi* Baird 1859 (1r).

RHINOPHRYNIDAE

*Rhinophrynus* Duméril and Bibron 1841: *dorsalis* Duméril and Bibron 1841.

BUFONIDAE

*Bufo* Laurenti 1768: *alvarius* Girard 1859; *angustipes* Taylor and Smith 1945; *arenarum* Hensel 1867; *blombergi* Myers and Funkhouser 1951; *bocourti* Brocchi 1877; *boreas* Baird and Girard 1853 (1r); *caeruleocellatus* Fowler 1913; *caeruloestictus* Günther 1859; *canaliferus* Cope 1877; *cavifrons* Firschein 1950; *ceratophrys* Boulenger 1882; *coccifer* Cope 1866; *coerulescens* (Cope) 1876; *cognatus* Say 1823 (2r); *compactilis* Wiegmann 1833; *coniferus* Cope 1862; *cophotis* Boulenger 1900; *cristatus* Wiegmann 1833; *crucifer* Wied 1821; *dapsilis* Myers and deCarvalho 1945; *debilis* Girard 1854 (2r); *diptychus* Cope 1862, *empusus* (Cope) 1862; *epioticus* (Cope) 1876; *fastidiosus* (Cope) 1876; *fissipes* Boulenger 1903; *gabbi* Taylor 1952; *gemmifer* Taylor 1939; *glaberrimus* Günther 1868; *granulosus* Spix 1824 (4r); *güntheri* Cochran 1941; *guttatus* Schneider 1799; *gutturosus* Daudin 1803; *haematiticus* Cope 1862; *holdridgei* Taylor 1952; *ibarrai* Stuart 1954; *inca* Stejneger 1913; *intermedius* Günther 1858; *lemur* (Cope) 1868 (2r); *leptoscelis* Boulenger 1912; *longinasus* Stejneger 1905; *luetkenii* Boulenger 1891; *marinus* (Linnaeus) 1757 (2r?); *marmoreus* Wiegmann 1833; *mazatlanensis* Taylor 1939; *melanochlorus* Cope 1876; *melini* Andersson 1945; *missionum* Berg 1896; ?*nayaritensis* Taylor 1943; *occidentalis* Camerano 1879; *ocellatus* Günther 1858; *ockendeni* Boulenger 1902; *paracnemis* Lutz 1925; *peltocephalus* Bibron 1838; *perplexus* Taylor 1943; *poeppigei* Tschudi 1845; *politus* Cope 1862; *punctatus* Baird and Girard 1852; *pygmaeus* Myers and deCarvalho 1952;

*rostratus* Noble 1920; *rufus* Garman 1876; *schneideri* Werner 1894; *simus* Schmidt 1858; *spinulosus* Wiegmann 1834; *tacanensis* Smith 1952; *typhonius* (Linnaeus) 1758; *valliceps* Wiegmann 1833; *variegatus* (Günther) 1870; *veraguensis* Schmidt 1858; *woodhousei* Girard 1854.

LEPTODACTYLIDAE

*Basanitia* Miranda Ribeiro 1923: *bolbodactyla* (Lutz) 1925; *lactea* Miranda Ribeiro 1923.

*Batrachophrynus* Peters 1873: *brachydactylus* Peters 1873; *macrostomus* Peters 1873.

*Batrachyla* Bell 1843: *leptopus* Bell 1843.

*Calytocephalella* Strand 1928: *gayi* (Duméril and Bibron) 1841; ?*testudiniceps* (Cope) 1862.

*Ceratophrys* Boie 1825: *appendiculata* Günther 1873; *bigibbosa* Peters 1872; *boiei* Wied 1825; *calcarata* Boulenger 1890; *cornuta* (Linnaeus) 1754; *cristiceps* Müller 1884; *fryi* Günther 1873; *goyanus* (Miranda Ribeiro) 1937; *ornata* (Bell) 1843; *pierottii* Vellard 1948; *renalis* (Miranda Riberio) 1920; *schirchi* (Miranda Ribeiro) 1937; *stolzmanni* Steindachner 1882; *testudo* Andersson 1945.

*Craspedoglossa* Müller 1922: *sanctae-catharinae* Müller 1922; *stejnegeri* (Noble) 1924.

*Crossodactylodes* Cochran 1938: *pintoi* Cochran 1938.

*Crossodactylus* Duméril and Bibron 1841: *aeneus* Müller 1924; *dispar* Lutz 1925; *gaudichaudii* Duméril and Bibron 1841; *trachystoma* (Reinhardt and Lütken) 1862.

?*Ctenocranius* Melin 1941: *koki* Melin 1941.

*Cycloramphus* Tschudi 1838: *asper* Werner 1899; *eleutherodactylus* (Miranda Ribeiro) 1920; *fulginosus* Tschudi 1838; *granulosus* Lutz 1929; *neglectus* Lutz 1928; *ohausi* (Wandolleck) 1907; *umbrinus* (Cope) 1867.

*Edalorhina* Espada 1871: *nasuta* Boulenger 1912; *perezi* Espada 1871.

*Eleutherodactylus* Duméril and Bibron 1841: *abbotti* Cochran 1923; *achatinus* (Boulenger) 1898; *acuminatus* Shreve 1935; *albipes* Barbour and Shreve 1937; *alfredi* (Boulenger) 1898; *altae* Dunn 1942; *altamazonicus* Barbour and Dunn 1921; *alticola* Lynn 1937; *andrewsi* Lynn 1937; *anomalus* (Boulenger) 1898; ?*anonymus* (Lutz) 1927; *anotis* Walker and Test 1955, *antillensis* (Reinhardt and Lütken) 1863; *anzuetoi* Stuart 1941; *appendiculatus* (Werner) 1894; *argyreornatus* (Miranda Ribeiro) 1926; *armstrongi* Noble and Hassler 1933; *atkinsi* Dunn 1925 (2r); *audanti* Cochran 1934; *augusti* (Dugès) 1879 (2r); *auriculatus* (Cope) 1862 (4r); *avocalis* Taylor and Smith 1945; *bakeri* Cochran 1935; *batrachylus* Taylor 1940; *beatae* (Boulenger) 1903; *beebei* Cochran 1956; *binotatus* (Spix) 1824; *biporcatus* (Peters) 1863; *bocourti* (Brocchi) 1877; *bogotensis* (Peters) 1863; *brederi* Dunn 1934; *brevicrus* Andersson 1945; *brevipalmatus* Schmidt 1920; *brevirostris* Shreve 1936; *briceni* (Boulenger) 1903; *brittoni* Schmidt 1920; *brocchi* (Bou-

lenger) 1882; *buckleyi* (Boulenger) 1882; *bufoniformis* (Boulenger) 1896; *bufonius* Andersson 1945; *cajamarcensis* Barbour and Noble 1920; *calcitrans* (Günther) 1900; *carmelitae* Ruthven 1922; *carrioni* Parker 1932; *carvalhoi* Lutz and Kloss 1952; *caryophyllaceus* (Barbour) 1928; *casparii* Dunn 1926; *cavernicola* Lynn 1954; *cerasinus* (Cope) 1876; *cochranae* Grant 1932; *conspicillatus* (Günther) 1858; *conspicuus* Taylor and Smith 1945; *cooki* Grant 1932; *cramptoni* Schmidt 1920; *crassidigitus* Taylor 1952; *crucifer* (Boulenger) 1899; *cruentus* (Peters) 1873; *cruralis* (Boulenger) 1902; *cubanus* Barbour 1942; *cundalli* Dunn 1926; *cuneatus* (Cope) 1862; *curtipes* (Boulenger) 1882; *darlingtoni* Cochran 1935; *decoratus* Taylor 1942; *delicatus* Ruthven 1917; *devillei* (Boulenger) 1880; *diastema* (Cope) 1876; *dimidiatus* (Cope) 1862; *discoidalis* (Peracca) 1895; *dorsoconcolor* Taylor 1941; *dubitus* Taylor 1952; *dunni* Barbour 1922; *eileenae* Dunn 1926; *elegans* (Peters) 1863; *emiliae* Dunn 1926; *engytympanum* (Günther) 1900; *erythropleura* (Boulenger) 1896; *euryglossus* (Cope) 1894; *femur-levis* Cochran 1935; *festae* (Peracca) 1904; *flavescens* Noble 1923; *flavomaculatus* Parker 1938; *fleischmanni* (Boettger) 1892; *florulentus* (Cope) 1894; *footei* Stejneger 1913; *frater* (Werner) 1899; *fuscus* Lynn and Dent 1943; *galdi* (Espada) 1870; *glandulifer* Cochran 1935; *glanduliferoides* Shreve 1936; *gollmeri* (Peters) 1863; *grabhami* Dunn 1926; *grandoculis* (Jeude) 1904; *granulosus* (Boulenger) 1903; *greggi* Bumzahem 1955; *greyi* Dunn 1926; *griseus* (Hallowell) 1860; *gryllus* Schmidt 1920; *guentheri* (Steindachner) 1864; *gularis* (Boulenger) 1898; *gulosus* (Cope) 1876; *gundlachi* Schmidt 1920; *haitianus* Barbour 1942; *hidalgoensis* Taylor 1942; ?*humeralis* Fowler 1916; *hylaeformis* (Cope) 1876; *inguinalis* Parker 1940; *inoptatus* (Barbour) 1914; *insignitus* Ruthven 1917; *intermedius* Barbour and Shreve 1937; *jamaicensis* Barbour 1910; *johnstonei* Barbour 1914; *jugans* Cochran 1937; *junori* Dunn 1926; *karlschmidti* Grant 1931; *laevissimus* (Werner) 1896; *laticeps* (Duméril) 1853; *latidiscus* (Boulenger) 1898; *lehmanii* (Boettger) 1892; *lentus* (Cope) 1862; *leptodactyloides* Andersson 1945; *locustus* Schmidt 1920; *loki* Shannon and Werler 1955; *longipes* (Baird) 1859; *longirostris* (Boulenger) 1898; *luteolus* (Gosse) 1851; *lutosus* (Barbour and Dunn) 1921 (2r); *lymani* Barbour and Noble 1920; *lynni* Goin and Cooper 1950; *macdougalli* Taylor 1942; *macrocephalus* (Peracca) 1904; *margaritifer* (Boulenger) 1912; *marmoratus* (Boulenger) 1900; *martinicensis* (Tschudi) 1838; *matudai* Taylor 1941; *maussi* (Boettger) 1893; *megacephalus* (Cope) 1876; *megalops* Ruthven 1917; *megalotympanum* Shannon and Werler 1955; *melanostictus* (Cope) 1876; *merendonensis* Schmidt 1933; *mexicanus* (Brocchi) 1879; *milesi* Schmidt 1933; *miliaris* (Spix) 1824; *mimus* Taylor 1955; *minutus* Noble 1923; *molinoi* (Barbour) 1928; *monensis* (Meerwarth) 1901; *monnichorum* Dunn 1940; *montanus* Schmidt 1919; *nasutus* (Lutz) 1925; *natator* Taylor 1938; *nigrovittatus* Andersson 1945; *noblei* Barbour and Dunn 1921; *nubilus* (Günther) 1901; *occidentalis* Taylor

1941; *ockendeni* (Boulenger) 1912; *orcutti* Dunn 1928; *ornatissima* (Despax) 1911; *oxyrhynchus* (Duméril and Bibron) 1841; *pagmae* (Fowler) 1913; *palmatus* (Boulenger) 1882; *palmeri* (Boulenger) 1912; *pantoni* Dunn 1926; *pastazensis* Andersson 1945; *pardalis* (Barbour) 1928; *parvus* (Girard) 1853; *peraltae* Barbour 1928; *peruvianus* (Melin) 1941; *petropolitanus* (Wandolleck) 1907; *pictissimus* Cochran 1935; *pinarensis* Dunn 1926; *pittieri* (Günther) 1900; *platydactylus* (Boulenger) 1903; *platyrhynchus* (Günther) 1900; *plicifera* (Boulenger) 1888; *poolei* Cochran 1938; *portoricensis* Schmidt 1927; *pseudoacuminatus* Shreve 1935; *puntariolus* (Peters) 1863; *ramagii* (Boulenger) 1888; *raniformis* (Boulenger) 1896; *ranoides* (Cope) 1886 (2r); *reticulatus* Walker and Test 1955; *rhodopis* (Cope) 1866; *ricordii* (Duméril and Bibron) 1841 (2r); *richmondi* Stejneger 1904; *ridens* (Cope) 1866; *riveti* (Despax) 1911; *roseus* (Boulenger) 1918; *roseus* [name preoccupied] Melin 1941; *rostralis* (Werner) 1896; *rufifemoralis* Noble and Hassler 1933; *rugosus* (Peters) 1873; *rugulosus* (Cope) 1869; *ruthae* Noble 1921; *sammartinensis* Shannon and Werler 1955; *sanctae-martae* Ruthven 1917; *sandersoni* Schmidt 1941; *saltator* Taylor 1941; *schmidti* Noble 1923 (2r); *semipalmatus* Shreve 1936; *sierra-maestrae* Schmidt 1920; *spatulatus* Smith 1939; *stadelmani* Schmidt 1936; *stantoni* Schmidt 1941; *stenodiscus* Walker and Test 1955; *subsigillatus* (Boulenger) 1902; *sulcatus* (Cope) 1874; *surdus* (Boulenger) 1882; *symingtoni* Schwartz 1957; *taeniatus* (Boulenger) 1912; *talamancae* Dunn 1931; *tarahumaraensis* Taylor 1940; *trachyblepharis* Boulenger 1918; *turquinensis* Barbour and Shreve 1937; *unicolor* Stejneger 1904; *unistrigatus* (Günther) 1859 (2r); *urichi* (Boettger) 1894; *varians* (Gundlach and Peters) 1864; *varleyi* Dunn 1925; *ventrilineatus* (Shreve) 1936; *ventrimarmoratus* (Boulenger) 1912; *ventrivittatus* Andersson 1945; *venustus* (Günther) 1900; *vertebralis* (Boulenger) 1886; *vilarsi* Melin 1941; *vocalis* Taylor 1939; *vocator* Taylor 1955; *vulcani* Shannon and Werler 1955; *weinlandi* Barbour 1914; *wightmanae* Schmidt 1920; *w-nigrum* (Boettger) 1892; *whymperi* (Boulenger) 1882.

*Elosia* Tschudi 1838: *aspera* Müller 1924; *lateristrogata* Baumann 1912; *mertensi* Bokermann 1956; *nasus* (Lichtenstein) 1823; *perplicata* Miranda Ribeiro 1926; *pulchra* Lutz 1951.

*Eupemphix* Steindachner 1863: *nattereri* Steindachner 1863; *paraensis* Müller 1923; *petersi* (Espada) 1872; *pustulosa* (Cope) 1864; *ruthveni* Netting 1930; *schereri* Myers 1942; *stentor* (Espada) 1872; *trinitatis* Boulenger 1889.

*Eupsophus* Fitzinger 1843: *bolitoglossus* (Werner) 1897; *calcaratus* (Günther) 1881; ?*columbianus* (Werner) 1899; *coppingeri* (Günther) 1881; *grayii* (Bell) 1843; *kriegi* (Müller) 1925; *lutzi* (Cochran) 1938; *miliaris* (Spix) 1824; *peruanus* (Peters) 1873; *petropolitanus* (Wandolleck) 1907; *quixensis* (Espada) 1872; *roseus* (Duméril and Bibron) 1841; *taeniatus* (Girard) 1854; *verrucosus* Miranda Ribeiro 1937; *wettsteini* Parker 1932.

*Holoaden* Miranda Ribeiro 1920: *lüderwaldti* Miranda Ribeiro 1920.

?*Hylopsis* Werner 1894: *platycephalus* Werner 1894.

*Hylorina* Bell 1843: *sylvatica* Bell 1843.

*Lepidobatrachus* Budgett 1899: *asper* Budgett 1899.

*Leptodactylus* Fitzinger 1826: *albilabris* (Günther) 1859; *andicola* Boettger 1891; *bolivianus* Boulenger 1898; *brevipes* Cope 1887; *bufo* Andersson 1911; *bufonius* Boulenger 1894; *chaquensis* Cei 1950; *curtus* Barbour and Noble 1920; *discodactylus* Boulenger 1883; *dominicensis* Cochran 1923; *dypticus* Boulenger 1918; *fallax* Müller 1926; *gaigeae* Cochran 1938; *gracilis* (Duméril and Bibron) 1841; *hallowellii* (Cope) 1862; *hemidactyloides* Andersson 1945; *hololius* Boulenger 1918; *hylaedactylus* (Cope) 1868; *insularum* Barbour 1906; *intermedius* Lutz 1930; *kreffti* Werner 1904; *labrosus* Espada 1875; *laticeps* Boulenger 1918; *longirostris* Boulenger 1882; *macroblepharus* Miranda Ribeiro 1926; *maculilabris* Boulenger 1896; *mantipus* Boulenger 1908; *martinezi* Bokermann 1956; *mystaceus* (Spix) 1824; *mystacinus* (Burmeister) 1861; *nigrescens* Andersson 1945; ?*occidentalis* Taylor 1937; *ocellatus* (Linnaeus) 1758 (2r); *ochraceus* Lutz 1930; *pallidirostris* Lutz 1930; *pentadactylus* (Laurenti) 1768 (4r); *poeppigi* Melin 1941; *prognathus* Boulenger 1888; *pulcher* Boulenger 1898; *pumilio* Boulenger 1920; *pustulatus* (Peters) 1870; *quadrivittatus* Cope 1894; *raniformis* Werner 1899; *rhodomystax* Boulenger 1883; *rhodonotus* (Günther) 1868; *rhodostigma* (Cope) 1874; *romani* Melin 1941; *rubido* (Cope) 1874; *rugosus* Noble 1923; *tuberculosus* Andersson 1945; *typhonius* (Daudin) 1802; *ventrimaculatus* Boulenger 1902; *vilarsi* Melin 1941; *wagneri* (Peters) 1862.

*Limnomedusa* Fitzinger 1843: *macroglossa* (Duméril and Bibron) 1841; *misionis* Schmidt 1944.

*Lithodytes* Fitzinger 1843: *cornutus* (Espada) 1870; *gaigei* Dunn 1931; *lineatus* (Schneider) 1799.

*Macrogenioglottus* deCarvalho 1946: *aliopioi* deCarvalho 1946.

*Megaelosia* Miranda Ribeiro 1923: *goeldii* (Baumann) 1912.

*Microbatrachylus* Taylor 1939: *albolabris* Taylor 1939; *bransfordii* (Cope) 1886; *costaricensis* Taylor 1952; *hobartsmithi* (Taylor) 1936; *imitator* Taylor 1942; *lineatissimus* Taylor 1941; *minimus* Taylor 1939; *montanus* Taylor 1942; *oaxacae* Taylor 1939; *persimilis* (Barbour) 1926; *polyptychus* (Cope) 1886; *pygmaeus* (Taylor) 1936; *rearki* Taylor 1952; *stejnegerianus* (Cope) 1893; *underwoodi* (Boulenger) 1896.

*Odontophrynus* Reinhardt and Lütken 1862: *americanus* (Duméril and Bibron) 1841; *cultripes* Reinhardt and Lütken 1862; *occidentalis* Berg 1896.

*Phrynanodus* Ahl 1933: *nanus* Ahl 1933.

*Physalaemus* Fitzinger 1826: *albifrons* (Spix) 1824; *biligonigera* (Cope) 1860; *bischoffi* (Boulenger) 1887; *cuvieri* Fitzinger 1826; *fuscomaculata* (Steindachner) 1864; *gracilis* (Boulenger) 1883; *henselii* (Peters) 1872; *moreirae* (Miranda Ribeiro) 1937; *mystacalis* (Cope) 1887; *nana*

(Boulenger) 1888; *olfersii* (Lichtenstein and Martens) 1856; *signiferus* (Girard) 1853; *ternetzi* (Miranda Ribeiro) 1937.

*Pleurodema* Tschudi 1838: *bibroni* Tschudi 1838; *bufonina* Bell 1843; *brachyops* (Cope) 1868; *cinerea* Cope 1877 (2r); *darwinii* Bell 1843; *diplolistris* (Peters) 1870; *illotus* (Barbour) 1922; *marmorata* (Duméril and Bibron) 1841; *nebulosa* (Burmeister) 1861; ?*pustulata* (Shreve) 1941; *sagittifer* (Schmidt) 1857; *tucumana* Parker 1927; *verrucosa* (Reinhardt and Lütken) 1862.

*Pseudopaludicola* Miranda Ribeiro 1926: *ameghini* (Cope) 1887; *boliviana* Parker 1927; *falcipes* (Hensel) 1867; *pusilla* (Ruthven) 1916; ?*saltica* Cope 1887.

*Syrrhopus* Cope 1878: *areolatus* Boulenger 1898; *calcaratus* Andersson 1945; *campi* Stejneger 1915; *chalceus* (Peters) 1873; *coeruleus* Andersson 1945; *cystignathoides* (Cope) 1877; *festae* (Peracca) 1904; *guttilatus* (Cope) 1879; *interorbitalis* Langebartel and Shannon 1956; *juninensis* Shreve 1938; *latodactylus* Taylor 1939; *leprus* Cope 1879; *modestus* Taylor 1942; *montium* Shreve 1938; *nebulosus* Taylor 1943; *petrophilus* Firschein 1954; *pipilans* Taylor 1940; *simonsii* Boulenger 1900; *smithi* Taylor 1940; *verrucipes* Cope 1885; *verruculatus* (Peters) 1870.

*Teletrema* Miranda Ribeiro 1937: *heterodactylum* Miranda Ribeiro 1937.

*Telmatobius* Wiegmann 1835: *arequipensis* Vellard 1955 (2r); *brevipes* Vellard 1951; *brevirostris* Vellard 1955 (3r); *cinereus* Noble 1921; *culeus* Garman 1875 (4r); *escomeli* Angel 1923 (3r); *halli* Noble 1938; *hauthali* Koslowsky 1895 (2r); *ignavus* Barbour and Noble 1920; *intermedius* Vellard 1951; *jelski* (Peters) 1873 (4r); *laevis* Philippi 1902; *latirostris* Vellard 1951; *marmoratus* (Duméril and Bibron) 1841 (3r); *montanus* Philippi 1902; *niger* Barbour and Noble 1920; *oxycephalus* Vellard 1946; *peruvianus* Wiegmann 1835; *rimac* Schmidt 1954 (2r); *sanborni* Schmidt 1954; *simonsi* Parker 1940; *verrucosus* Werner 1899; *walkeri* Shreve 1941.

*Telmatobufo* Schmidt 1952: *bullocki* Schmidt 1952.

*Tomodactylus* Günther 1900: *albolabris* Taylor 1943; *amulae* Günther 1900; *angustidigitorum* Taylor 1939; *dilatus* Davis and Dixon 1955; *fuscus* Davis and Dixon 1955; *macrotympanum* Taylor 1939; *nitidus* (Peters) 1869; *petersi* Duellman 1954.

*Zachaenus* Cope 1866: *parvulus* (Girard) 1853; *roseus* Cope 1890; *sawayae* Cochran 1953.

HYLIDAE

*Acris* Duméril and Bibron 1841: *crepitans* Baird 1854.

*Allophryne* Gaige 1926: *ruthveni* Gaige 1926.

*Amphignathodon* Boulenger 1882: *guentheri* Boulenger 1882.

*Amphodus* Peters 1872: *auratus* Boulenger 1917; *piperatus* (Miranda Ribeiro) 1923; *wuchereri* Peters 1872.

*Anotheca* Smith 1939: *coronata* (Stejneger) 1911.

*Aparasphenodon* Miranda Ribeiro 1920: *brunoi* Miranda Ribeiro 1920.

*Aplastodiscus* Lutz 1950: *perviridis* Lutz 1950.

*Cerathyla* Espada 1870: *braconnieri* Espada 1870; *bubalus* Espada 1870; ?*cristata* (Andersson) 1945; *fasciata* (Peters) 1862; *palmarum* Espada 1870; *panamensis* Stejneger 1917; *proboscidea* Espada 1870.

*Corythomantis* Boulenger 1896: *greeningi* Boulenger 1896; *schubarti* Miranda Ribeiro 1937; *venezolana* Mertens 1950.

*Cryptobatrachus* Ruthven 1916: *fuhrmanni* (Peracca) 1914; *incertus* Barbour 1926.

*Diaglena* Cope 1887: *reticulata* Taylor 1942; *spatulata* (Günther) 1882.

*Flectonotus* Miranda Ribeiro 1926: *ulei* Miranda Ribeiro 1926.

*Garbeana* Miranda Ribeiro 1926: *garbei* Miranda Ribeiro 1926.

*Gastrotheca* Fitzinger 1843: *angustifrons* (Boulenger) 1898; *argenteovirens* (Boettger) 1892; *bolivianum* (Steindachner) 1892; *cornutum* (Boulenger) 1898; *ernestoi* Miranda Ribeiro 1920; *fissipes* (Boulenger) 1888; *fitzgeraldi* Parker 1933; *helenae* Dunn 1944; *longipes* (Boulenger) 1882; *marsupiatum* (Duméril and Bibron) 1841; *microdiscus* (Andersson) 1910; *monticola* Barbour and Noble 1920; *nicefori* Gaige 1933; *oviferum* (Lichtenstein and Weinland) 1854; *peruanum* (Boulenger) 1900; *plumbeum* (Boulenger) 1882; *pygmaeum* (Boettger) 1893; *testudineum* (Espada) 1870; *viridis* Lutz and Lutz 1939; *viviparum* (Andersson) 1945; *weinlandii* (Steindachner) 1892; *williamsoni* Gaige 1922.

*Hemiphractus* Wagler 1828: *divaricatus* Cope 1868; *scutatus* (Spix) 1824.

*Hyla* Laurenti 1768: *acuminata* Cope 1862; *albida* Melin 1941; *albofrenata* Lutz 1924; *alboguttata* Boulenger 1882; *albolineata* Lutz and Lutz 1939; *albomarginata* Spix 1824; *albonigra* Nieden 1923; *albopunctulata* Boulenger 1882; *albosignata* Lutz and Lutz 1938; *alleei* Taylor 1952; *alleni* Goin 1957; *aluminiata* Andersson 1906; *alvaradoi* Taylor 1952; *alvarengai* Bokermann 1956; *anceps* Lutz 1929; *angustilineata* Taylor 1952; *anisitzi* (Méhely) 1904; *appendiculata* Boulenger 1882; *arborescandens* Taylor 1938; *arboricola* Taylor 1941; *arenicolor* Cope 1866; *armata* Boulenger 1902; *aurantiaca* Daudin 1803; *auraria* Peters 1873; *axillamembrana* Shannon and Werler 1955; *azteca* (Taylor) 1943; *balzani* Boulenger 1898; *baudinii* Duméril and Bibron 1841; *beltrani* Taylor 1942; *bifurca* Andersson 1945; *bipunctata* Spix 1824 (2r); *bischoffi* Boulenger 1887 (2r); *bistincta* Cope 1877 (2r); *bocourti* (Mocquard) 1899; *boulengeri* (Cope) 1887; *bromeliacia* Schmidt 1933; *brunnea* Gosse 1851; *calcarata* Troschel 1848; *callipleura* Boulenger 1902; *capitocarinata* Andersson 1945; *cappellei* (Jeude) 1904; *cárdenasi* Taylor 1938; *carinata* Andersson 1939; *carnea* (Cope) 1868; *catharinae* Boulenger 1888; *ceratophrys* Stejneger 1911; *cherrei* Cope 1894; *chimboe* Fowler 1913; *claresignata* Lutz and Lutz 1939; *clepsydra* Lutz 1925; *cochranae* Mertens 1952; *columbiana* Boettger 1892; *colymba* Dunn 1931; *coriacea* Peters 1867; *crassa* (Brocchi) 1877; *crepitans* Wied 1824; *crospedospila* Lutz 1925; *cuspidata* Lutz 1925; *cyclomaculata* Taylor 1949; *dalquesti* Taylor 1949; *darlingi* Smith and

Werler 1952; *dasynota* Günther 1868; *debilis* Taylor 1952; *decipiens* Lutz 1925; *dendroscarta* Taylor 1940; *depressa* Andersson 1945; *depressiceps* Boulenger 1882; *dolloi* Werner 1903; *dominicensis* (Tschudi) 1838; *dorisae* (Goin) 1957; *ebraccata* Cope 1874; *ehrhardti* Müller 1924; *elaeochroa* Cope 1876; *elongata* Lutz 1925; *erythromma* Taylor 1937; *euphorbiacea* Günther 1858; *euthysanota* Kellogg 1928; *evansi* Boulenger 1904; *evelynae* Schmidt 1944; *eximia* Baird 1854; *faber* Wied 1821; *favosa* Cope 1886; *festae* Peracca 1904; *fiebrigi* Ahl 1927; *fimbrimembra* Taylor 1948; *forbesi* Taylor 1939; *funerea* (Cope) 1874; *fuscomarginata* Lutz 1925; *fuscovaria* Lutz 1925; *gabbii* Cope 1876; *geographica* Spix 1824 (2r); *giesleri* Mertens 1950; *glandulosa* Boulenger 1883; *godmani* Günther 1901; *goeldii* Boulenger 1894; *goughi* Boulenger 1911 (2r); *granosa* Boulenger 1882 (2r); *guentheri* Boulenger 1886; *habra* (Goin) 1957; *hayii* Barbour 1909; *hazelae* Taylor 1939; *heilprini* Noble 1923; *helenae* Ruthven 1919; *humilis* Lutz 1954; *hypocellata* Miranda Ribeiro 1926; *hypselops* (Cope) 1870; *imitator* (Barbour and Dunn) 1926; *imitatrix* Miranda Ribeiro 1926; *immensa* Taylor 1952; *indris* (Cope) 1867; *inframaculata* Boulenger 1882; *lafrentzi* Mertens 1929; *lanciformis* (Cope) 1870; *langsdorffii* Duméril and Bibron 1841; *laynei* Goin 1957; *leonard-schultzei* Ahl 1934; *leptoscelis* Boulenger 1918; *leucophyllata* (Beireis) 1783; *lichenata* (Gosse) 1851; *lineomaculata* Werner 1899; *lindneri* Müller and Hellmich 1936; *loquax* Gaige and Stuart 1934; *luteo-ocellata* Roux 1927; *lutzi* Melin 1941; *macrotis* Andersson 1945; *macrotympanum* Tanner 1957; *manisorum* Taylor 1954; *marginata* Boulenger 1887; *marianae* Dunn 1926; *marmorata* (Laurenti) 1768; *maxima* (Laurenti) 1768; *melanargyrea* Cope 1887; *melanomma* Taylor 1939; *melanopleura* Boulenger 1912; *membranacea* Andersson 1945; *mesophaea* Hensel 1867; *microcentra* Werner 1921; *microcephala* Cope 1886 (2r); *microeximia* Maslin 1957; *microps* Peters 1872; ?*microterodisca* Werner 1921; *miliaria* (Cope) 1886; *milleri* Shannon 1951; *mimetica* Melin 1941; *minima* Ahl 1933; *minuta* Peters 1872; *miotympanum* Cope 1863; *miranda-ribeiri* Melin 1941; *misera* Werner 1903; *mixomaculata* Taylor 1950; *mocquardi* Günther 1901; *molitor* Schmidt 1857; *moraviaensis* Taylor 1952; *musica* Lutz 1949; *nana* Boulenger 1889; *nasica* Cope 1862; *nebulosa* Spix 1824; *nigra* Cope 1887; *nigripes* Cope 1876; *ocapia* Andersson 1939; *ocellifera* Boulenger 1899; *orcesi* Funkhouser 1956; *ornatissima* Noble 1923; *pachycrus* Miranda Ribeiro 1937; *pachyderma* Taylor 1942; *palliata* Cope 1863; *palmeri* Boulenger 1908; *palpebrogranulata* Andersson 1906; *pardalis* Spix 1824; *parkeri* Gaige 1929; *parviceps* Boulenger 1882; *pearsoni* Gaige 1929; *pellucens* Werner 1901; *perpusilla* Lutz and Lutz 1939; *phaeota* Cope 1862 (2r); *phantasmagoria* Dunn 1943; *phlebodes* Stejneger 1906; *phrynoderma* Boulenger 1889; *phyllognatha* Melin 1941; *picadoi* Dunn 1937; *pickeli* Lutz and Lutz 1938; *picta* (Günther) 1901; *picturata* Boulenger 1899; *pinorum* Taylor 1937; *planiceps* (Cope) 1874; *platydactyla* Boulenger

1905; *plicata* Brocchi 1877; *polytaenia* Cope 1869; *porifera* Andersson 1945; *prasina* Burmeister 1856; *proboscidea* Brongersma 1933; *pseudopuma* Günther 1901; *pseudopseudis* Miranda Ribeiro 1937; *pulchrilineata* Cope 1869; *pulicaria* Werner 1901; *puma* Cope 1885; *punctata* (Schneider) 1799; *pusilla* Melin 1941; *quadrangulum* Boulenger 1882; *quinquefasciata* Fowler 1913; *quitoe* Fowler 1913; *raddiana* Fitzinger 1826 (2r); *regilla* Baird and Girard 1852; *resinifictrix* Goeldi 1907; *reticulata* Espada 1870; *rhodopepla* Günther 1858; *richard-taylori* Taylor 1954; *riobambae* Fowler 1913; *riojana* Koslowsky 1895; *riopastazae* Andersson 1945; *rivularis* Taylor 1952; *robertmertensi* Taylor 1937; *robertsorum* Taylor 1939; *robustofemora* Taylor 1939; *roeschmanni* deGrys 1938; *rosenbergi* Boulenger 1898; *rostrata* Peters 1863; *rubicundula* Reinhardt and Lütken 1862; *rubra* Daudin 1803 (4r); *rufioculis* Taylor 1952; *rufopunctata* Andersson 1906; *salvadorensis* Mertens 1952; *sanborni* Schmidt 1944; ?*schebestana* Werner 1926; *senicula* Cope 1868; *septentrionalis* (Tschudi) 1838; *shrevei* Taylor 1952; *siemersi* Mertens 1937; *similis* Cochran 1952; *smaragdina* Taylor 1940; *smithii* Boulenger 1902; *sordida* Peters 1863; *spectrum* Reinhardt and Lütken 1862; *spegazzinii* Boulenger 1899; *spinosa* Steindachner 1864; *splendens* Schmidt 1857; *squaliorostris* Lutz 1925; *stadelmani* Schmidt 1936; *steinbachi* Boulenger 1905; *strigilata* Spix 1824 (2r); *subocularis* Dunn 1934; *sumichrasti* (Brocchi) 1879; *taeniopus* Günther 1901; *taurina* (Fitzinger) 1843; *tenera* (Reinhardt and Lütken) 1862; *tintinnabulum* Melin 1941; *trachythorax* Müller and Hellmich 1936; *trapicheiroi* Lutz 1954; *tuberculosa* Boulenger 1882; *underwoodi* Boulenger 1899; *uranochroa* Cope 1876; *uruguaya* Schmidt 1944; *valancifer* Firschein and Smith 1956; *variabilis* Boulenger 1896; *vasta* Cope 1871; *verrucigera* Werner 1901; *vilarsi* Melin 1941; *vilsoniana* Cope 1899 (2r); *vittigera* Werner 1894; *vogli* Müller 1938; *walkeri* Stuart 1954; *wavrini* Parker 1936; *wellmanorum* Taylor 1952; *werneri* Cochran 1952; *wettsteini* Ahl 1933; *weyerae* Taylor 1954; *wilderi* Dunn 1925; ?*wrightorum* Taylor 1938; *zernyi* Ahl 1933; *zeteki* Gaige 1929.

*Hyloscirtus* Peters 1882: *bogotensis* (Peters) 1882.

*Nototheca* Bokermann 1950: *fissilis* (Miranda Ribeiro) 1920.

*Nyctimantis* Boulenger 1882: *rugiceps* Boulenger 1882.

*Phrynohyas* Fitzinger 1843: *corasterias* Shannon and Humphrey 1955; *hebes* (Cope) 1862; *inflata* (Taylor) 1944; *ingens* Duellman 1956; *latifasciata* Duellman 1956; *modesta* (Taylor and Smith) 1945; *spilomma* (Cope) 1877; *zonata* (Spix) 1824.

*Phyllomedusa* Wagler 1830: *aspera* (Peters) 1872; *bahiana* Lutz 1925; *bicolor* (Boddaert) 1772; *blombergi* Funkhouser 1957; *boliviana* Boulenger 1902; *buckleyi* Boulenger 1882; *burmeisteri* Boulenger 1882; *calcarifer* (Boulenger) 1902; *callidryas* (Cope) 1862 (2r); *coelestis* (Cope) 1874; *craspedopus* Funkhouser 1957; *dacnicolor* Cope 1864; *edentula* Andersson 1945; *feltoni* Shreve 1935; *fimbriata* (Miranda

Ribeiro) 1923; *guttata* Lutz 1925; *helenae* (Cope) 1885; *hypochondrialis* (Daudin) 1803; *iheringi* Boulenger 1885; *lemur* Boulenger 1882; *loris* Boulenger 1912; *moreleti* (Duméril) 1853; *nicefori* Barbour 1926; *orcesi* Funkhouser 1957; *perlata* Boulenger 1883; *rohdei* Mertens 1926; *saltator* (Taylor) 1955; *sauvagii* Boulenger 1882; *spurrelli* (Boulenger) 1913; *tarsius* (Cope) 1868; *tomopterna* (Cope) 1868; *trinitatis* Mertens 1926; *vaillantii* Boulenger 1882.

*Plectrohyla* Brocchi 1877: *avia* Stuart 1952; *cotzicensis* Stuart 1948; *guatemalensis* Brocchi 1877; *ixil* Stuart 1942; *lacertosa* Bumzahem and Smith 1954; *matudai* Hartweg 1941 (2r); *quecchi* Stuart 1942; *sagorum* Hartweg 1941.

*Pseudis* Wagler 1830: *bolbodactyla* Lutz 1925; *fusca* Garman 1883; *laevis* Parker 1935; *limellum* (Cope) 1862; *mantidactyla* Cope 1862; *meridionalis* Miranda Ribeiro 1926; *minuta* Günther 1858; *paradoxa* (Linnaeus) 1754.

*Pseudohyla* Andersson 1945: *nigrogrisea* Andersson 1945.

*Pternohyla* Boulenger 1882: *dentata* Smith 1957; *fodiens* Boulenger 1882.

*Ptychohyla* Taylor 1944: *adipoventris* Taylor 1944; *bogerti* Taylor 1949; *rozellae* (Taylor) 1942; *schmidtorum* Stuart 1954; *spinipollex* (Schmidt) 1936.

*Tetraprion* Stejneger and Test 1891: *jordani* Stejneger and Test 1891.

*Trachycephalus* Tschudi 1838: *nigromaculatus* Tschudi 1838.

*Triprion* Cope 1866: *petasatus* (Cope) 1865.

CENTROLENIDAE

*Centrolene* Espada 1872: *antioquiensis* (Noble) 1920; *geckoideum* Espada 1872; *parabambae* (Boulenger) 1898; *prosoblepon* (Boettger) 1892; *ritae* Lutz and Kloss 1952.

*Cochranella* Taylor 1951; *albomacultata* (Taylor) 1949; *albotunica* Taylor and Cochran 1953; *bokermanni* Taylor and Cochran 1953; *buckleyi* (Boulenger) 1882; *chrysops* (Cope) 1894; *colymbiphyllum* (Taylor) 1949; *delicatissima* Taylor and Cochran 1953; *divaricans* Taylor and Cochran 1953; *dubia* Taylor and Cochran 1953; *eurygnatha* (Lutz) 1925; *fleischmanni* (Boettger) 1893; *granulosa* (Taylor) 1949; *lutzorum* Taylor and Cochran 1953; *ocellata* (Boulenger) 1918; *parvula* (Boulenger) 1894; *petropolitana* Taylor and Cochran 1953; *pulverata* (Peters) 1873; *surda* Taylor and Cochran 1953; *talamancae* Taylor 1952; *uranoscopa* (Müller) 1924; *valerioi* (Dunn) 1931; *vanzolinii* Taylor and Cochran 1953; *viridissima* (Taylor) 1942.

*Teratohyla* Taylor 1951: *spinosa* (Taylor) 1949.

BRACHYCEPHALIDAE

*Atelopus* Duméril and Bibron 1841: *bicolor* Noble 1921; *boulengeri* Peracca 1904; *bufoniformis* Peracca 1904; *carinatus* Andersson 1945; *carrikeri* Ruthven 1916; *chiriquiensis* Shreve 1936; *cruciger* (Lichtenstein and Martens) 1856; *elegans* (Boulenger) 1882; *erythropus* Boulenger 1903; *festae* Peracca 1904; *flavescens* Duméril and Bibron 1841; *ignescens*

(Cornalia) 1849; *longirostris* Cope 1868; *minutus* Melin 1941; *moreirae* Miranda Ribeiro 1920 (2r); *oxyrhynchus* Boulenger 1903; *palmatus* Andersson 1945; *proboscideus* (Boulenger) 1882; *pulcher* (Boulenger) 1882; *rubriventris* Vellard 1947; *rugulosus* Noble 1921; *seminiferus* Cope 1874; *senex* Taylor 1952; *spurrelli* Boulenger 1914 (2r); *tumifrons* Boulenger 1905; *tricolor* Boulenger 1902; *varius* Stannius 1856 (4r).

*Brachycephalus* Fitzinger 1826; *ephippium* (Spix) 1824.

*Dendrobates* Wagler 1830: *auratus* (Girard) 1854; ?*bassleri* Melin 1941; *fantasticus* Boulenger 1884; *galindoi* Trapido 1953; *histrionicus* Berthold 1845; *labialis* Cope 1874; *lugubris* Schmidt 1858; *minutus* Shreve 1935 (2r); *opisthomelas* Boulenger 1899; *paravaensis* Boulenger 1913; *parvulus* Boulenger 1882; *pictus* Duméril and Bibron 1841 (5r); *pumilio* Schmidt 1858; *reticulatus* Boulenger 1884; *shrevei* Dunn 1940; *speciosus* Schmidt 1858; *tinctorius* (Schneider) 1799 (4r); *trivittatus* (Spix) 1824.

*Dendrophryniscus* Espada 1871: *brevipollicatus* Espada 1871; *stelzneri* (Weyenberg) 1875 (3r).

*Geobatrachus* Ruthven 1915: *walkeri* Ruthven 1915.

*Noblella* Barbour 1930: *brasiliensis* (Parker) 1926; *peruvianus* (Noble) 1921.

*Oreophrynella* Boulenger 1895: *macconnelli* Boulenger 1900; *quelchii* (Boulenger) 1895.

*Phyllobates* Duméril and Bibron 1841: *anthonyi* Noble 1921; *aurotaenia* (Boulenger) 1913; *bicolor* Duméril and Bibron 1841; *bromelicola* Test 1956; *brunneus* (Cope) 1887; *espinosai* Funkhouser 1956; *infraguttatus* Boulenger 1898; *kingsburyi* Boulenger 1918; *latinasus* Cope 1863; *mandelorum* Schmidt 1932; *melanorhinus* Berthold 1845; *nicefori* Noble 1923; *nubicola* Dunn 1924 (2r); *pratti* Boulenger 1899; *riocosangae* Andersson 1945; *subpunctatus* (Cope) 1899; *sylvatica* Barbour and Noble 1920; *taeniatus* Andersson 1945; *talamancae* (Cope) 1875; *trilienatus* Boulenger 1884; *vertebralis* (Boulenger) 1899; *whymperi* (Boulenger) 1882.

*Prostherapis* Cope 1868: *alboguttatus* (Boulenger) 1903; *bocagei* (Espada) 1871; *bolivianus* Boulenger 1902; *boulengeri* Barbour 1909; *chocoensis* (Boulenger) 1912; *collaris* (Boulenger) 1912; *femoralis* Boulenger 1884; *festae* Peracca 1904; *fuliginosus* (Espada) 1871; *inguinalis* Cope 1868; ?*marchesianus* (Melin) 1941; *neblina* Test 1956; *palmatus* (Werner) 1899 (2r); *panamensis* (Dunn) 1933; *pulchellus* (Espada) 1875; *tricolor* Boulenger 1899; *trinitatus* (Garman) 1888; *vergeli* (Hellmich) 1940.

*Rhinoderma* Duméril and Bibron 1841: *darwinii* Duméril and Bibron 1841.

*Sminthillus* Barbour and Noble 1920: *limbatus* (Cope) 1862 (2r).

MICROHYLIDAE

*Arcovomer* deCarvalho 1954: *passarellii* deCarvalho 1954.

*Chiasmocleis* Méhely 1904: *albopunctata* (Boettger) 1885; *bassleri* Dunn

1949; *bicegoi* Miranda Ribeiro 1920; *centralis* Bokermann 1952; *hudsoni* Parker 1940; *leucosticta* (Boulenger) 1888; *panamensis* Dunn, Trapido and Evans 1948; *schubarti* Bokermann 1952; *shudikarensis* Dunn 1949; *urbanae* Bokermann 1952; *ventrimaculata* (Andersson) 1945.

*Ctenophryne* Mocquard 1904: *geayi* Mocquard 1904.

*Dasypops* Miranda Ribeiro 1924: *schirchi* Miranda Ribeiro 1924.

*Dermatonotus* Méhely 1904: *mülleri* (Boettger) 1885.

*Elachistoceleis* Parker 1927: *bicolor* (Valenciennes) 1838; *ovalis* (Schneider) 1799.

*Gastrophryne* Fitzinger 1843: *carolinensis* (Holbrook) 1836 (2r); *elegans* (Boulenger) 1882; *pictiventris* (Cope) 1886; *usta* (Cope) 1866 (2r).

*Glossostoma* Günther 1900: *aequatoriale* (Peracca) 1904; *aterrimum* Günther 1900.

*Hamptophryne* deCarvalho 1954: *boliviana* (Parker) 1927.

*Hyophryne* deCarvalho 1954: *histrio* deCarvalho 1954.

*Hypopachus* Keferstein 1867: *alboventer* Taylor 1940 (2r); *aquae* Stuart 1952; *barberi* Schmidt 1939; *caprimimus* Taylor 1940; *championi* Stuart 1940; *cuneus* Cope 1889 (2r); *globulosus* Schmidt 1939; *inguinalis* Cope 1869; *maculatus* Taylor 1940; *ovis* Taylor 1940; *oxyrhinus* Boulenger 1883; *simus* Stuart 1941; *variolosus* (Cope) 1866.

*Myersiella* deCarvalho 1954: *subnigra* (Miranda Ribeiro) 1920.

*Otophryne* Boulenger 1900: *robusta* Boulenger 1900.

*Relictivomer* deCarvalho 1954: *pearsei* (Ruthven) 1914.

*Stereocyclops* Cope 1871: *incrassatus* Cope 1871.

*Synapturanus* deCarvalho 1954: *microps* (Duméril and Bibron) 1841.

RANIDAE

*Rana* Linnaeus 1758: *aurora* Baird and Girard 1852 (1r); *catesbeiana* Shaw 1802; *dunni* Zweifel 1957; *megapoda* Taylor 1942; *miadis* Barbour and Loveridge 1929; *montezumae* Baird 1854; *moorei* Blair 1947; *palmipes* Spix 1824; *pipiens* Schreber 1782 (2r); *pueblae* Zweifel 1955; *pustulosa* Boulenger 1883; *sierramadrensis* Taylor 1938; *sinaloae* Zweifel 1954; *tarahumarae* Boulenger 1917; *vibicaria* (Cope) 1894; *warschewitschii* (Schmidt) 1857.

## North America

(north of Mexico)

ASCAPHIDAE

*Ascaphus* Stejneger 1899: *truei* Stejneger 1899 (3r).

PELOBATIDAE

*Scaphiopus* Holbrook 1836: *bombifrons* Cope 1863; *couchi* Baird 1854; *hammondi* Baird 1859 (1r); *holbrooki* (Harlan) 1835; *hurteri* Strecker 1910; *intermontanus* Cope 1883.

BUFONIDAE

*Bufo* Laurenti 1768: *alvarius* Girard 1859; *boreas* Baird and Girard 1852 (4r); *canorus* Camp 1916; *cognatus* Say 1823; *compactilis* Wiegmann

1833 (1r); *debilis* Girard 1854 (3r); *houstonensis* Sanders 1953; *microscaphus* Cope 1867 (2r); *punctatus* Baird and Girard 1852; *quercicus* Holbrook 1840; *terrestris* (Bonnaterre) 1789 (3r); *valliceps* Wiegmann 1833; *woodhousei* Girard 1854 (4r).

LEPTODACTYLIDAE

*Eleutherodactylus* Duméril and Bibron 1841: *augusti* (Dugès) 1879; *latrans* (Cope) 1880.

*Leptodactylus* Fitzinger 1826: *labialis* (Cope) 1877.

*Syrrhophus* Cope 1878: *campi* Stejneger 1915; *marnocki* Cope 1878.

HYLIDAE

*Acris* Duméril and Bibron 1841: *gryllus* (LeConte) 1825 (4r).

*Hyla* Laurenti 1768: *andersoni* Baird 1854; *arenicolor* Cope 1866; *baudini* Duméril and Bibron 1841; *cinerea* (Schneider) 1799 (2r); *crucifer* Wied 1838 (2r); *eximia* Baird 1854 (1r); *femoralis* Sonnini and Latreille 1802; *gratiosa* LeConte 1856; *ocularis* Bosc and Daudin 1801; *phaeocrypta* Cope 1889 (2r); *regilla* Baird and Girard 1852; *squirella* Sonnini and Latreille 1802; *versicolor* LeConte 1825 (3r).

*Pseudacris* Fitzinger 1843: *brachyphona* (Cope) 1889; *brimleyi* Brandt and Walker 1933; *clarki* (Baird) 1854; *nigrita* (LeConte) 1825 (5r); *ornata* (Holbrook) 1836; *streckeri* Wright and Wright 1933 (2r).

MICROHYLIDAE

*Gastrophryne* Fitzinger 1843: *carolinensis* (Holbrook) 1836 (3r).

*Hypopachus* Keferstein 1867: *cuneus* Cope 1889 (1r).

RANIDAE

*Rana* Linnaeus 1758: *areolata* Baird and Girard 1852 (2r); *aurora* Baird and Girard 1852 (3r); *boyli* Baird 1854 (3r); *capito* LeConte 1855 (2r); *catesbeiana* Shaw 1802; *clamitans* Latreille 1802; *grylio* Stejneger 1901; *heckscheri* Wright 1924; *palustris* LeConte 1825; *pipiens* Schreber 1782 (5r); *pretiosa* Baird and Girard 1853 (2r); *septentrionalis* Baird 1854; *sylvatica* LeConte 1825 (2r); *tarahumarae* Boulenger 1917; *virgatipes* Cope 1891.

## Europe

DISCOGLOSSIDAE

*Alytes* Wagler 1830: *cisternasii* Bosca 1879; *obstetricans* (Laurenti) 1768 (2r).

*Bombina* Oken 1816: *bombina* (Linnaeus) 1761; *variegata* (Linnaeus) 1758 (4r).

*Discoglossus* Otth 1837: *pictus* Otth 1837 (2r).

PELOBATIDAE

*Pelobates* Wagler 1830: *cultripes* (Cuvier) 1829; *fuscus* (Laurenti) 1768 (2r); *syriacus* Boettger 1889 (1r).

*Pelodytes* Bonaparte 1838: *caucasicus* Boulenger 1896; *punctatus* (Daudin) 1802.

BUFONIDAE

*Bufo* Laurenti 1768: *bufo* (Linnaeus) 1758 (4r); *calamita* Laurenti 1768; *viridis* Laurenti 1768 (1r).

HYLIDAE

*Hyla* Laurenti 1768: *arborea* (Linnaeus) 1758 (6r).

RANIDAE

*Rana* Linnaeus 1758: *arvalis* Nilsson 1842 (3r); *camerani* Boulenger 1886; *dalmatina* Bonaparte 1840; *esculenta* Linnaeus 1758; *graeca* Boulenger 1891; *iberica* Boulenger 1879; *latastei* Boulenger 1879; *macrocnemis* Boulenger 1885; *ridibunda* Pallas 1771 (2r); *temporaria* Linnaeus 1758 (3r).

**Asia**

DISCOGLOSSIDAE

*Barbourula* Taylor and Noble 1924: *busuangensis* Taylor and Noble 1924.

*Bombina* Oken 1816: *bombina* (Linnaeus) 1761; *maxima* (Boulenger) 1905; *orientalis* (Boulenger) 1890.

*Discoglossus* Otth 1837: *nigriventer* Mendelssohn and Steinitz 1943.

PELOBATIDAE

*Aelurophryne* Boulenger 1919: *brevipes* Liu 1950; *glandulata* Liu 1950; *maculata* Liu 1950; *mammata* (Günther) 1896; *tainingensis* Liu 1950.

*Leptobrachella* Smith 1925: *baluensis* Smith 1931; *mjobergi* Smith 1925.

*Megophrys* Kuhl and van Hasselt 1822: *abbotti* Cochran 1926; *aceras* (Boulenger) 1903; *baluensis* (Boulenger) 1899; *boettgeri* (Boulenger) 1899; *boulengeri* (Bedriaga) 1898; *carinensis* (Boulenger) 1889; *feae* (Boulenger) 1887; *gracilis* (Günther) 1872; *hasseltii* (Tschudi) 1838 (3r); *heteropus* (Boulenger) 1900; *intermedius* (Smith) 1921; *kuatunensis* Pope 1929; *lateralis* (Anderson) 1871; *longipes* (Boulenger) 1885; *minor* Stejneger 1926; *monticola* Kuhl and van Hasselt 1822 (4r); *natunae* (Günther) 1895; *omeimontis* Liu 1950; *oshanensis* Liu 1950; *palpebralespinosa* Bourret 1937; *parva* (Boulenger) 1893; *pelodytoides* (Boulenger) 1893; *robusta* (Boulenger) 1908; *shapingensis* Liu 1950.

*Pelobates* Wagler 1830: *fuscus* (Laurenti) 1768 (1r); *syriacus* Boettger 1889 (2r).

*Scutiger* Theobald 1868: *alticola* (Procter) 1922; *pingii* Liu 1943; *popei* Liu 1947; *rugosa* Liu 1943; *schmidti* Liu 1947; *sikkimensis* (Blyth) 1855.

*Vibrissaphora* Liu 1945: *boringii* Liu 1945; *liui* Pope 1947.

BUFONIDAE

*Ansonia* Stoliczka 1870: *leptopus* (Günther) 1872; *muelleri* (Boulenger) 1887; *penangensis* (Stoliczka) 1870.

*Bufo* Laurenti 1768: *abutus* Ahl 1929; *andersonii* Boulenger 1883; *asper* Gravenhorst 1829; *bankorensis* Barbour 1908; *beddomii* Günther 1875; *biporcatus* Gravenhorst 1829 (2r); *brevirostris* Rao 1937; *bufo* (Linnaeus) 1754 (6r); *burmanus* Andersson 1939; *celebensis* Schlegel 1858;

*claviger* Peters 1863; *cruentatus* Tschudi 1838; *dhufarensis* Parker 1931; *divergens* Peters 1871; *fergusonii* Boulenger 1892; *fuligineus* Mocquard 1890; *galeatus* Günther 1864; *gymnauchen* Bleeker 1859; *himalayanus* Günther 1864; *hololius* Günther 1875; *kelaartii* Günther 1858; *latastii* Boulenger 1882; *longecristatus* Werner 1903; *luristanicus* Schmidt 1952; *melanostictus* Schneider 1799; *microtympanum* Boulenger 1882; *obscurus* (Barbour) 1904; *olivaceus* Blanford 1874; *orientalis* Werner 1895; *pageoti* Bourret 1937; *parietalis* Boulenger 1882; *parvus* Boulenger 1887; *persicus* Nikolsky 1900; *pulcher* Boulenger 1882; *quadriportatus* Boulenger 1887; *raddei* Strauch 1876; *spinulifer* Mocquard 1890; *stomaticus* Lütken 1863; *stuarti* Smith 1929; *sumatranus* Peters 1871; *surdus* Boulenger 1891; *tibetanus* Zarevsky 1925; *tienhoensis* Bourret 1937; *valhallae* Meade-Waldo 1909; *viridis* Laurenti 1768.

*Cacophryne* Davis 1935: *borbonica* (Kuhl and van Hasselt) 1827.

*Ophryophryne* Boulenger 1903: *microstoma* Boulenger 1903; *poilani* Bourret 1937.

*Pedostibes* Günther 1875: *altitudinis* (Smith) 1931; *everetti* (Boulenger) 1896; *hosii* (Boulenger) 1892; *kempii* (Boulenger) 1919; *picturata* (Smith) 1921; *tuberculosa* Günther 1875.

*Pelophryne* Barbour 1938: *albotaeniata* Barbour 1938; *brevipes* (Peters) 1867; *güntheri* (Boulenger) 1882; *macrotis* (Boulenger) 1887; *maculata* (Mocquard) 1890; *misera* (Mocquard) 1890; *signata* (Boulenger) 1894.

*Pseudobufo* Tschudi 1838: *subasper* Tschudi 1838; *werneri* (van Kampen) 1905.

LEPTODACTYLIDAE

*Crinia* Tschudi 1883: *signifera* (Girard) 1853 (1r).

*Lechriodus* Boulenger 1882: *fletcheri* (Boulenger) 1890; *melanopyga* (Doria) 1875; *papuanus* (Roux) 1927; *platyceps* Parker 1940.

*Limnodynastes* Fitzinger 1843: *convexiusculus* (Macleay) 1828.

HYLIDAE

*Hyla* Laurenti 1768: *albolabris* Wandolleck 1911; *angiana* Boulenger 1915; *angularis* Loveridge 1945; *annectans* (Jerdon) 1870; *arborea* Schlegel 1838; *arfakiana* Peters and Doria 1878; *aruensis* Horst 1883; *becki* Loveridge 1945; *bicolor* (Gray) 1842; *brachypus* (Werner) 1898; *brongersmai* Loveridge 1945; *caerulea* (Shaw) 1790; *chinensis* Günther 1858; *chloronota* (Boulenger) 1911; *congenita* Peters and Doria 1878; *darlingtoni* Loveridge 1945; *eucnemis* Lönnberg 1900; *everetti* Boulenger 1897; *genimaculata* Horst 1833; *graminea* Boulenger 1905; *hallowelli* van Denburgh 1909; *humeralis* Boulenger 1912; *infrafrenata* Günther 1867 (2r); ?*javana* Ahl 1926; *jeudi* Werner 1901; *longicrus* (Boulenger) 1911; *lutea* Boulenger 1887; *militaria* (Ramsey) 1878; *montana* Peters and Doria 1878 (2r); *nasuta* (Gray) 1842; *nigropunctata* (Meyer) 1874; *obsoleta* Lönnberg 1900; *obtusirostris* (Meyer)

1874; *papuensis* Werner 1901; *pygmaea* (Meyer) 1874; *rhacophorus* van Kampen 1909; *rueppelli* Boettger 1895; *sanchiangensis* Pope 1931; *sanguinolenta* van Kampen 1909; *simplex* Boettger 1901; *solomonis* Vogt 1912; *thesaurensis* Peters 1877; *vagabunda* Peters and Doria 1878; *wirzi* Roux 1928; *wollastoni* Boulenger 1914; *wolterstorffi* (Werner) 1901.

*Nyctimystes* Stejneger 1916: *amboinensis* Horst 1883; *flavomaculata* Forcart 1953; *granti* (Boulenger) 1914; *gularis* Parker 1936; *loveridgei* Neill 1954; *milneana* Loveridge 1945; *montana* Parker 1936; *papua* (Boulenger) 1897; *semipalmata* Parker 1936.

MICROHYLIDAE

*Asterophrys* Tschudi 1838: *amboinensis* (Mertens) 1930; *boettgeri* (Méhely) 1901; *bouwensi* (deWitte) 1930; *doriae* (Boulenger) 1888; *dubia* (Boettger) 1895; *fusca* (Peters) 1867; *louisiadensis* Parker 1934; *microtis* (Werner) 1901; *minima* Parker 1934; *oxycephala* (Schlegel) 1858; *robusta* (Boulenger) 1898; *rufescens* (Macleay) 1878; *similis* Zweifel 1956; *slateri* Loveridge 1955; *turpicola* (Müller) 1837; *valvifera* (Barbour) 1910; *wilhelmana* Loveridge 1948.

*Baragenys* Parker 1936: *atra* (Günther) 1896; *cheesmanae* Parker 1936; *kopsteini* (Mertens) 1931.

*Calluella* Stoliczka 1872: *guttulata* (Blyth) 1855; *ocellata* Liu 1950; *volzi* (van Kampen) 1905; *yunnanensis* Boulenger 1919.

*Chaperina* Mocquard 1892: *fusca* Mocquard 1892.

*Colpoglossus* Boulenger 1904: *brooksi* Boulenger 1904; *smithi* (Barbour and Noble) 1916.

*Cophixalus* Boettger 1892: *ateles* (Boulenger) 1898; *biroi* (Méhely) 1901 (2r); *cheesmanae* Parker 1934; *cryptotympanum* Zweifel 1956; *daymani* Zweifel 1956; *geislerorum* Boettger 1892; *montanus* (Boettger) 1895; *ornatus* (Fry) 1912; *oxyrhinus* (Boulenger) 1898; *pansus* (Fry) 1917; *rostellifer* (Wandolleck) 1910; *shellyi* Zweifel 1956; *variegatus* (van Kampen) 1923 (2r); *verrucosus* (Boulenger) 1898.

*Gastrophrynoides* Noble 1926: *borneense* (Boulenger) 1897.

*Genyophryne* Boulenger 1890: *thomsoni* Boulenger 1890.

*Glyphoglossus* Günther 1868: *molossus* Günther 1868.

*Kalophrynus* Tschudi 1838: *bunguranus* (Günther) 1895; *pleurostigma* Tschudi 1838 (2r); *punctatus* (Peters) 1871; *robinsoni* Smith 1922.

*Kaloula* Gray 1831: *baleata* (Müller) 1836 (3r); *borealis* (Barbour) 1908; *conjuncta* (Peters) 1863 (4r); *macroptica* Liu 1945; *mediolineata* (Smith) 1917; *picta* (Duméril and Bibron) 1841; *pulchra* Gray 1831 (4r); *rigida* Taylor 1922; *rugifera* Stejneger 1924; *verrucosa* (Boulenger) 1904.

*Melanobatrachus* Beddome 1878: *indicus* Beddome 1878.

*Metaphrynella* Parker 1934: *pollicaris* (Boulenger) 1890; *sundana* (Peters) 1867.

*Metopostira* Méhely 1901: *ocellata* Méhely 1901.

*Microbatrachus* Roux 1910: *pusillus* Roux 1910.

*Microhyla* Tschudi 1838: *achatina* Tschudi 1838; *annamensis* Smith 1923;

*annectens* Boulenger 1900; *berdmorei* (Blyth) 1856; *borneensis* Parker 1926; *butleri* Boulenger 1900; *fusca* Andersson 1943; *heymonsi* Vogt 1911; *inornata* Boulenger 1890; *okinavensis* Stejneger 1901; *ornata* (Duméril and Bibron) 1841; *palmipes* Boulenger 1897; *picta* Schenkel 1901; *pulchra* (Hallowell) 1860; *rubra* (Jerdon) 1854; *superciliaris* Parker 1928; *zeylanica* Parker and Hill 1949.

*Oreophryne* Boettger 1895: *albopunctata* (van Kampen) 1909; *annulata* (Stejneger) 1908; *anthonyi* (Boulenger) 1897; *biroi* (Méhely) 1897; *brevicrus* Zweifel 1956; *celebensis* (Müller) 1894; *crucifera* (van Kampen) 1913; *flava* Parker 1934; *frontifasciata* (Horst) 1883; *idenburgensis* Zweifel 1956; *inornata* Zweifel 1956; *insulana* Zweifel 1956; *jeffersoniana* Dunn 1928; *kampeni* Parker 1934; *moluccensis* (Peters and Doria) 1878; *monticola* (Boulenger) 1897; *parkeri* Loveridge 1955; *rookmaakeri* Mertens 1927; *variabilis* (Boulenger) 1899; *zimmeri* Ahl 1933.

*Phrynella* Boulenger 1887: *pulchra* Boulenger 1887.

*Ramanella* Rao and Ramanna 1925: *anamalaiensis* Rao 1937; *minor* Rao 1937; *montana* (Jerdon) 1854; *mormorata* Rao 1937; *obscura* (Günther) 1864; *palmata* Parker 1934; *triangularis* (Günther) 1875; *variegata* (Stoliczka) 1872.

*Sphenophryne* Peters and Doria 1878: *brevicrus* (van Kampen) 1913; *brevipes* (Boulenger) 1897; *cornuta* Peters and Doria 1878; *crassa* Zweifel 1956; *macrorhyncha* (van Kampen) 1906; *méhelyi* Parker 1934; *palmipes* Zweifel 1956; *polysticta* (Méhely) 1901; *rhodoactyla* (Boulenger) 1897; *schlaginhaufeni* Wandolleck 1911.

*Uperodon* Duméril and Bibron 1841: *globulosum* (Günther) 1864; *systoma* (Schneider) 1799.

*Xenobatrachus* Peters and Doria 1878: *bidens* (van Kampen) 1909; *giganteus* (van Kampen) 1915; *macrops* (van Kampen) 1913; *ocellatus* (van Kampen) 1913; *ophiodon* Peters and Doria 1878; *rostratus* (Méhely) 1898.

RANIDAE

*Altirana* Stejneger 1927: *parkeri* Stejneger 1927.

*Batrachylodes* Boulenger 1887: *trossulus* Brown and Myers 1949; *vertebralis* Boulenger 1887.

*Ceratobatrachus* Boulenger 1884: *guentheri* Boulenger 1884.

*Cornufer* Tschudi 1839: *cornutus* Taylor 1922; *guentheri* Boulenger 1882; *guppyi* Boulenger 1884; *hazelae* (Taylor) 1920; *neckeri* Brown and Myers 1949; *polillensis* (Taylor) 1922; *subterrestris* Taylor 1922; *unicolor* Tschudi 1839; *vitiensis* (Girard) 1853.

*Discodeles* Boulenger 1918: *bufoniformis* (Boulenger) 1884; *guppyi* (Boulenger) 1884; *opisthodon* (Boulenger) 1884.

*Micrixalus* Boulenger 1888: *baluensis* (Boulenger) 1896; *borealis* Annandale 1912; *fuscus* (Boulenger) 1882; *herrei* Myers 1942; *mariae* Inger 1954; *opisthorhodus* (Günther) 1868; ?*sarasinorum* (Müller) 1887; *saxicola* (Jerdon) 1853; *silvaticus* (Boulenger) 1882; *tenasserimensis* (Sclater) 1892; *torrentis* Smith 1923.

*Nannobatrachus* Boulenger 1882: *anamallaiensis* Myers 1942; *beddomi* Boulenger 1882; *kempholeyensis* Rao 1937.

*Nannophrys* Günther 1868: *ceylonensis* Günther 1868 (2r); *guentheri* Boulenger 1882.

*Nanorana* Günther 1896: *pleskei* Günther 1896.

*Nyctibatrachus* Boulenger 1882: *humayuni* Bhaduri and Kripalani 1955; *major* Boulenger 1882; *pygmaeus* (Günther) 1875; *sancti-palustris* Rao 1920 (2r); *sylvaticus* Rao 1937.

*Ooeidozyga* Kuhl and Van Hasselt 1822: *baluensis* (Boulenger) 1896; *celebensis* Smith 1927; *diminutive* (Taylor) 1922; *floresiana* (Mertens) 1927; *laevis* (Günther) 1858 (3r); *lima* (Kuhl and Gravenhorst) 1829; *semipalmata* Smith 1927.

*Palmatorappia* Ahl 1927: *solomonis* (Sternfeld) 1920.

*Platymantis* Günther 1858: *aculeodactylus* Brown 1953; *beauforti* (van Kampen) 1913; *boulengeri* (Boettger) 1892; *cheesmani* Parker 1940; *corrugatus* (Duméril) 1853 (5r); *meyeri* Günther 1873; *myersi* Brown 1949; *punctata* Peters and Doria 1878; *solomonsis* (Boulenger) 1884; *vitianus* (Duméril) 1853.

*Rana* Linnaeus 1758: *adenopleura* Boulenger 1909; *aenea* Smith 1922; *alticola* Boulenger 1882; *andersonii* Boulenger 1882; *annandalii* Boulenger 1920; *arathooni* Smith 1927; *arfaki* Meyer 1874; *arvalis* Nilsson 1842 (2r); *assamensis* Sclater 1892; *aurantiaca* Boulenger 1904; *baramica* Boettger 1901; *beddomii* (Günther) 1875; *bhagmandlensis* Rao 1922; *blanfordii* Boulenger 1882; *boulengeri* Günther 1899; *breviceps* Schneider 1799; *brevipalmata* Peters 1871; *camerani* Boulenger 1886; *cancrivora* Gravenhorst 1829 (3r); *cavitympanum* Boulenger 1893; *celebensis* Peters 1872; *chalconota* (Schlegel) 1837; *chaochiaoensis* Liu 1946; *chapaensis* Bourret 1937; *corrugata* Peters 1863; *crassiovis* Boulenger 1920; *cubitalis* Smith 1917; *curtipes* Jerdon 1853; *cyanophlyctis* Schneider 1799; *daemeli* (Steindachner) 1868; *debussyi* van Kampen 1910; *diplosticta* (Günther) 1875; *dobsonii* Boulenger 1882; *doriae* Boulenger 1887; *elberti* Roux 1911; *erythraea* (Schlegel) 1837; *esculenta* Linnaeus 1758 (2r); *everetti* Boulenger 1882 (3r); *fansipani* Bourret 1939; *feae* Boulenger 1887; *florensis* Boulenger 1897; *gammiei* Anderson 1871; *garoensis* Boulenger 1920; *gerbillus* Annandale 1912; *gracilipes* Gressitt 1938; *gracilis* Gravenhorst 1829 (2r); *greenii* Boulenger 1904; *grisea* van Kampen 1913 (3r); *grunniens* Daudin 1803; *guentheri* Boulenger 1882; *haschaena* (Stoliczka) 1870; *heinrichi* Ahl 1933; *hexadactyla* Lesson 1834; *holstii* Boulenger 1892; *hosii* Boulenger 1891; *humeralis* Boulenger 1887; *intermedius* Rao 1937; *ishikawae* Stejneger 1901; *japonica* Boulenger 1879 (2r); *jerboa* (Günther) 1872; *kampeni* Boulenger 1920; *kaulbacki* Smith 1940; *khammonensis* Smith 1929; *kohchangae* Smith 1922; *kuhlii* Duméril and Bibron 1841; *lateralis* Boulenger 1887; *laticeps* Boulenger 1882; *latouchii* Boulenger 1899; *leithii* Boulenger 1888; *leptodactyla* Boulenger 1882; *leptoglossa* (Cope) 1868; *leucorhynchus* Rao 1937; *liebigii* Günther 1860; *limnocharis* Boie 1835 (6r); *livida* (Blyth) 1855; *longimanus*

Andersson 1939; *luctuosa* (Peters) 1871; *macrocnemis* Boulenger 1885; *macrodactyla* (Günther) 1858; *macrodon* Duméril and Bibron 1841 (6r); *macrognathus* Boulenger 1917 (2r); *macrops* Boulenger 1897; *malabarica* Tschudi 1838; ?*mangischlakensis* Ahl 1925; *maosonensis* Bourret 1937; *margaretae* Liu 1950; *melanomenta* Taylor 1920; *micrixalus* Taylor 1923; *microdisca* Boettger 1892 (4r); *microlineata* Bourret 1937; *microtympanus* van Kampen 1907; *milleti* Smith 1921; *miopus* Boulenger 1918; *modesta* Boulenger 1882; *monticola* (Anderson) 1871; *montivago* Smith 1921; *namiyei* Stejneger 1901; *narina* Stejneger 1901; *nasica* Boulenger 1903; *nicobariensis* (Stoliczka) 1870 (2r); *nigromaculata* Hallowell 1860 (4r); *nigrovittata* (Blyth) 1855; *nitida* Smedley 1931; *oatesii* Boulenger 1892; *okinavana* Boettger 1895; *papua* Lesson 1830 (3r); *parambikulamana* Rao 1937; *parva* Taylor 1920; *persimilis* van Kampen 1923; *phrynoderma* Boulenger 1882; *phrynoides* Boulenger 1917; *picturata* Boulenger 1920; *pileata* Boulenger 1916; *plancyi* Lataste 1880; *pleuraden* Boulenger 1904; *plicatella* Stoliczka 1873; *polunini* Smith 1951; *ridibunda* Pallas 1771 (3r); *rufescens* (Jerdon) 1854; *rugosa* Schlegel 1838; *sanguinea* Boettger 1893; *sauriceps* Rao 1937; *sauteri* Boulenger 1909 (2r); *schmackeri* Boettger 1892; *semipalmata* Boulenger 1882; *shuchinae* Liu 1950; *signata* (Günther) 1872 (4r); *spinosa* David 1875 (2r); *spinulosa* Smith 1922; *sternosignata* Murray 1885; *strachani* (Murray) 1884; *subaspersa* Barbour 1908; *swani* Myers and Leviton 1956; *swinhoana* Boulenger 1903; *tagoi* Okada 1929; *taipehensis* van Denburgh 1909; *temporalis* (Günther) 1864; *temporaria* Linnaeus 1758 (10r); *tenuilingua* Rao 1937; *tigrina* Daudin 1803 (4r); *toumanoffi* Bourret 1941; *tweediei* Smith 1935; *verrucosa* Günther 1875; *vicina* Stoliczka 1872; *whiteheadi* Boulenger 1887; *woodworthi* Taylor 1923; *yunnanensis* Anderson 1879; ?*zographi* Terentjev 1922.

*Simomantis* Boulenger 1918: *latopalmata* (Boulenger) 1887.

*Staurois* Cope 1865; *afghana* (Günther) 1858; *chunganensis* (Pope) 1929; *formosae* (Günther) 1875; *hainanensis* Boulenger 1899; *himalayanus* (Boulenger) 1888; *hongkongensis* Pope and Romer 1951; *kangtingensis* Liu 1950; *larutensis* (Boulenger) 1899; *lifanensis* Liu 1945; *loloensis* Liu 1950; *mantzorum* (David) 1871; *natator* (Günther) 1858; *ricketti* (Boulenger) 1899 (2r); *tuberilinguis* Boulenger 1918.

RHACOPHORIDAE

*Philautus* Tschudi 1838: *acutirostris* (Peters) 1867; *alticola* (Ahl) 1931; *amoenus* Smith 1931; *andersoni* (Ahl) 1927; *annandalii* (Boulenger) 1906; *argus* (Annandale) 1912; *asperrimus* (Ahl) 1927; *aurifasciatus* (Schlegel) 1837; *banaensis* Bourret 1939; ?*bimaculatus* (Peters) 1867; *bombayensis* (Annandale) 1919; *brevipes* (Boulenger) 1908; *carinensis* (Boulenger) 1893; *castanomerus* (Boulenger) 1905; *chalazodes* (Günther) 1875; *charius* Rao 1937; *cornutus* (Boulenger) 1920; *doriae* (Boulenger) 1893; *elegans* Rao 1937; *flaviventris* (Boulenger) 1882; *garo* (Boulenger) 1919; *glandulosus* (Jerdon) 1853; *gracilipes* Bourret 1937; *gryllus* Smith 1924; *hansenae* Cochran 1927; *horridus* (Boulen-

ger) 1903; *jacobsoni* (van Kampen) 1912; *kempiae* (Boulenger) 1919; *kottigeharensis* Rao 1937; *laevis* Smith 1924; *larutensis* (Boulenger) 1900; *leitensis* (Boulenger) 1897; *leucorhinus* (Lichtenstein and Martens) 1856; *longicrus* (Boulenger) 1894; *longicrus* [name preoccupied] Rao 1937; *maosonensis* Bourret 1937; *melanensis* Rao 1937; *montanus* Rao 1937; *narainensis* Rao 1937; *nasutus* (Günther) 1868; *noblei* (Ahl) 1927; *nongkhorensis* (Cochran) 1924; *pallidipes* (Barbour) 1908; *palpebralis* Smith 1924; *parkeri* (Ahl) 1927; *parvulus* (Boulenger) 1893; *petersi* (Boulenger) 1900; *pictus* (Peters) 1871; *pulcherrimus* (Ahl) 1927; *romeri* Smith 1953; *schmackeri* (Boettger) 1892; *schmardanus* (Kelaart) 1854; *signatus* (Boulenger) 1882; *similis* van Kampen 1923; *simus* (Annandale) 1915; *spiculatus* Smith 1931; ?*spinosus* (Taylor) 1920; *striatus* (Ahl) 1930; *swamianus* Rao 1937; *travancoricus* (Boulenger) 1891; *tytthus* Smith 1940; *variabilis* (Günther) 1858; *vermiculatus* (Boulenger) 1900; *vittatus* (Boulenger) 1887; *vittiger* (Boulenger) 1897; *williamsi* Taylor 1922.

*Rhacophorus* Kuhl 1827: *appendiculatus* (Günther) 1858 (2r); *baluensis* Inger 1954; *bambusicola* (Barbour) 1920; *buergeri* (Schlegel) 1838 (? 13r); *chenfui* Liu 1945; *cruciger* (Blyth) 1852 (2r); *dulitensis* Boulenger 1892; *durgritei* (David) 1871; *edentulus* Müller 1894; *emembranatus* Inger 1954; *eques* (Günther) 1858; *fasciatus* Boulenger 1895; *hecticus* (Peters) 1863; *leporosus* (Müller) 1838 (5r); *leucomystax* (Kuhl) 1829 (4r); *lissobrachius* Inger 1954; ?*microtympanum* (Günther) 1858; *mutus* Smith 1940; *nigropalmatus* Boulenger 1895 (5r); *notater* Smith 1924; *otilophus* Boulenger 1893; *pardalis* Günther 1858 (5r); *reinwardtii* (Boie) 1830 (4r); *robustus* Boulenger 1909; *schlegelii* (Günther) 1858 (? 16r); *surdus* (Peters) 1863; *taeniatus* Boulenger 1906; *taronensis* Smith 1940; *turpes* Smith 1940.

## Australia
(including New Zealand)

LEIOPELMATIDAE

*Leiopelma* Fitzinger 1861: *archeyi* Turbott 1942; *hamiltoni* (McCulloch) 1919; *hochstetteri* Fitzinger 1861.

LEPTODACTYLIDAE

*Adelotus* Ogilby 1907: *brevis* (Günther) 1863.

*Crinia* Tschudi 1838: *acutirostris* Andersson 1916; *darlingtoni* Loveridge 1933; *georgiana* Tschudi 1838; *glauerti* Loveridge 1933; *haswelli* Fletcher 1894; *insignifera* Moore 1954; *laevis* (Günther) 1864 (3r); *leai* Fletcher 1898; *parinsignifera* Main 1957; *pseudinsignifera* Main 1957; *rosea* Harrison 1927; *signifera* Girard 1853 (3r); *subinsignifera* Littlejohn 1957; *tasmaniensis* (Günther) 1864.

*Cyclorama* Steindachner 1867: *alboguttatus* (Günther) 1867; *australis* (Gray) 1842; *brevipes* (Peters) 1871; *cultripes* Parker 1940; *dahlii* (Boulenger) 1896; *inermis* (Peters) 1867; *platycephalus* (Günther) 1873; *slevini* Loveridge 1950.

*Glauertia* Loveridge 1933: *mjöbergi* (Andersson) 1913; *orientalis* Parker 1940; *russelli* Loveridge 1933.

*Heleioporus* Gray 1841: *albopunctatus* (Gray) 1841; *australiacus* (Shaw) 1795; *eyrei* (Gray) 1845; *inornatus* Lee and Main 1954; *psammophilus* Lee and Main 1954.

*Lechriodus* Boulenger 1882: *fletcheri* (Boulenger) 1890.

*Limmodynastes* Fitzinger 1843: *convexiusculus* (Macleay) 1828; *dorsalis* (Gray) 1841 (5r); *fletcheri* Boulenger 1888; *ornatus* (Gray) 1842; *peronii* (Duméril and Bibron) 1841; *salmini* Steindachner 1867; *spenceri* Parker 1940; *tasmaniensis* Günther 1858.

*Metacrinia* Parker 1940: *nichollsi* (Harrison) 1927.

*Mixophyes* Günther 1864: *fasciolatus* Günther 1864 (2r).

*Myobatrachus* Schlegel 1850: *gouldii* (Gray) 1841.

*Neobatrachus* Peters 1863: *centralis* (Parker) 1940; *pelobatoides* (Werner) 1914; *pictus* Peters 1863; *sutor* Main 1957; *wilsmorei* (Parker) 1940.

*Notaden* Günther 1873: *bennetti* Günther 1873; *nichollsi* Parker 1940.

*Philoria* Spencer 1901: *frosti* Spencer 1901; *loveridgei* Parker 1940.

*Pseudophryne* Fitzinger 1843: *australis* (Gray) 1835; *bibroni* Günther 1858; *coriacea* Keferstein 1868; *corroboree* Moore 1953; *dendyi* Lucas 1892; *guentheri* Boulenger 1882; *major* Parker 1940; *occidentalis* Parker 1940; *semimarmorata* Lucas 1892.

*Uperoleia* Gray 1841: *marmorata* Gray 1841; *rugosa* (Andersson) 1916.

HYLIDAE

*Hyla* Laurenti 1768: *adelaidensis* Gray 1841; *aurea* (Lesson) 1830 (4r); *bicolor* (Gray) 1842 (2r); *blandsuttoni* Procter 1924; *burrowsi* Scott 1942; *caerulea* (Shaw) 1790 (2r); *chloris* Boulenger 1893; *citropa* (Tschudi) 1838; *cyclorhynchus* Boulenger 1882; *dayi* Günther 1897; *dentata* Keferstein 1868; *eucnemis* Lönnberg 1900; *ewingii* Duméril and Bibron 1841 (6r); *freycineti* (Tschudi) 1838; *gracilenta* Peters 1870; *infrafrenata* Günther 1867; *inguinalis* Ahl 1935; *irrorata* deVis 1884; *jenolanensis* Copland 1957; *jervisiensis* Duméril and Bibron 1841; *kinghorni* Loveridge 1950; *latopalmata* (Günther) 1867; *lesueurii* Duméril and Bibron 1841; *maculata* Spencer 1901; *moorei* Copland 1957; *nasuta* (Gray) 1842; *obsoleta* Lönnberg 1900 (1r); *parvidens* Peters 1875; *peronii* (Tschudi) 1838; *phyllochroa* Günther 1863 (2r); *rubella* Gray 1842.

MICROHYLIDAE

*Cophixalus* Boettger 1892: *ornatus* (Fry) 1912.

*Stenophryne* Peters and Doria 1878: *gracilipes* (Fry) 1912; *robusta* (Fry) 1912.

RANIDAE

*Rana* Linnaeus 1758: *daemeli* (Steindachner) 1868.

## Africa

(including Madagascar and Seychelles)

PIPIDAE

*Hymenochirus* Boulenger 1896: *boettgeri* (Tornier) 1896 (2r); *boulengeri* deWitte 1930; *curtipes* Noble 1924; *feae* Boulenger 1906.

*Pseudhymenochirus* Chabanaud 1920: *merlini* Chabanaud 1920.

*Xenopus* Wagler 1827: *clivii* Peracca 1898; *fraseri* Boulenger 1905; *gilli* Rose and Hewitt 1928; *laevis* (Daudin) 1803 (5r); *muelleri* (Peters) 1844; *tropicalis* (Gray) 1864.

DISCOGLOSSIDAE

*Discoglossus* Otth 1837: *pictus* Otth 1837 (1r).

PELOBATIDAE

*Nesomantis* Boulenger 1908: *thomasseti* Boulenger 1908.

*Pelobates* Wagler 1830; *fuscus* (Laurenti) 1768 (1r).

*Sooglossus* Boulenger 1906: *gardineri* (Boulenger) 1911; *sechellensis* (Boettger) 1896.

BUFONIDAE

*Bufo* Laurenti 1768: *angusticeps* Smith 1849 (2r); *anotis* Boulenger 1907; *berghei* Laurent 1950; *blanfordii* Boulenger 1882; *brauni* Nieden 1910; *brevipalmata* Ahl 1924; *buchneri* Peters 1882; *bufo* (Linnaeus) 1754 (1r); *camerunensis* Parker 1936 (2r); *carens* Smith 1849; *chevalieri* Mocquard 1908; *chudeaui* Chabanaud 1919; *dodsoni* Boulenger 1895; *dombensis* Bocage 1895; *fenoulheti* Hewitt and Methuen 1913 (3r); *fuliginatus* deWitte 1932; *funereus* Bocage 1866; *gardoensis* Scortecci 1933; *gariepensis* Smith 1849; *ghappuisi* Roux 1936; *granti* Boulenger 1903; *hoeschi* Ahl 1934; *jordani* Parker 1936; *katanganus* Loveridge 1932; *latifrons* Boulenger 1900; *lemairii* Boulenger 1901; *lindneri* Mertens 1955; *lönnbergi* Andersson 1911 (2r); *lughensis* Loveridge 1932; *mauritanicus* Schlegel 1841; *micranotis* Loveridge 1925 (2r); *mocquardi* Angel 1924; *osgoodi* Loveridge 1932; *parkeri* Loveridge 1932; *pentoni* Anderson 1893; *preussi* Matschie 1893; *regularis* Reuss 1834 (9r); *rosei* Hewitt 1926; *sibilai* Scortecci 1929; *somalicus* Calabresi 1927; *steindachnerii* *Pfeffer* 1893; *superciliaris* Boulenger 1887; *taitanus* Peters 1878 (4r); *togoensis* Ahl 1924; *tradouwi* Hewitt 1926; *tuberosus* Günther 1858; *urunguensis* Loveridge 1932; *ushoranus* Loveridge 1932; *vertebralis* Smith 1849 (2r); *villiersi* Angel 1940; *viridis* Laurenti 1768; *vittatus* Boulenger 1906.

*Didynamipus* Andersson 1903: *sjöstedti* Andersson 1903.

*Heleophryne* Sclater 1899: *natalensis* Hewitt 1913; *purcelli* Sclater 1899 (3r); *regis* Hewitt 1909; *rosei* Hewitt 1925.

*Nectophryne* Buchholz and Peters 1875: *afra* Buchholz and Peters 1875; *batesii* Boulenger 1913.

*Nectophrynoides* Noble 1926: *occidentalis* Angel 1943; *tornieri* (Roux) 1906; *vivipara* (Tornier) 1905.

*Werneria* Poche 1903: *fulva* (Andersson) 1903.
*Wolterstorffina* Mertens 1939: *parkeri* Laurent 1950; *parvipalmata* (Werner) 1898.

HYLIDAE

*Hyla* Laurenti 1768: *arborea* Schlegel 1838 (2r).

MICROHYLIDAE

*Anodonthyla* Müller 1892: *boulengeri* Müller 1892; *montana* Angel 1925.
*Breviceps* Merrem 1820: *adspersus* Peters 1882; *fasciatus* FitzSimons 1950; *fuscus* Hewitt 1925; *gibbosus* (Linnaeus) 1758; *macrops* Boulenger 1907; *maculatus* FitzSimons 1947; *montanus* Power 1926; *mossambicus* Peters 1854; *namaquensis* Power 1926; *pentheri* Werner 1899 (2r); *poweri* Parker 1934; *rosei* Power 1926; *striatus* Hoffman 1940; *sylvestris* FitzSimons 1930; *tympanifer* Hewitt 1925; *vanisoni* FitzSimons 1946; *verrucosus* Rapp 1842.
*Callulina* Nieden 1910: *kreffti* Nieden 1910.
*Cophyla* Boettger 1880: *phyllodactyla* Boettger 1880.
*Dyscophus* Grandidier 1872: *antongili* Grandidier 1877; *beloensis* Mocquard 1902; *grandidieri* Boulenger 1896; *guineti* (Grandidier) 1875; *insularis* Grandidier 1872; *quinquelineatus* Boettger 1913.
*Fichteria* Scortecci 1941: *somalica* Scortecci 1941.
*Hoplophryne* Barbour and Loveridge 1928: *rogersi* Barbour and Loveridge 1928; *uluguruensis* Barbour and Loveridge 1928.
*Mantipus* Peters 1883: ?*anguliferus* (Werner) 1903; *hildebrandti* Peters 1883; *inguinalis* (Boulenger) 1882; *laevipes* (Mocquard) 1895; *pulcher* Ahl 1928.
*Paracophyla* Millot and Guibé 1951: *tuberculata* Millot and Guibé 1951.
*Parhoplophryne* Barbour and Loveridge 1928: *usambaricus* Barbour and Loveridge 1928.
*Platyhyla* Boulenger 1889: *grandis* Boulenger 1889.
*Platypelis* Boulenger 1882: *barbouri* Noble 1940; *cowani* Boulenger 1882; *milloti* Guibé 1950; *pollicaris* Boulenger 1888; *tuberculata* (Ahl) 1929; *tuberifera* (Methuen) 1919.
*Plethodontohyla* Boulenger 1882: *alluaudi* (Mocquard) 1901; *brevipes* Boulenger 1882; *coudreani* Angel 1938; *laevis* (Boettger) 1913 (2r); *notosticta* (Günther) 1877; *ocellata* Noble and Parker 1926; *tuberata* (Peters) 1883.
*Probreviceps* Parker 1931: *macrodactylus* (Nieden) 1926 (3r); *uluguruensis* (Loveridge) 1925.
*Rhombophryne* Boettger 1880: *testudo* Boettger 1880.
*Spelaeophryne* Ahl 1924: *methneri* Ahl 1924.
*Stumpffia* Boettger 1881: *madagascariensis* Mocquard 1895; *psologlossa* Boettger 1881.

PHRYNOMERIDAE

*Phrynomerus* Noble 1926: *affinis* (Boulenger) 1901; *annectens* (Werner) 1910; *bifasciata* (Smith) 1847 (2r); *hoeschi* Parker 1940.

RANIDAE

*Anhydrophryne* Hewitt 1919: *rattrayi* Hewitt 1919.

*Arthroleptides* Nieden 1910: *dutoiti* Loveridge 1935; *martiensseni* Nieden 1910.

*Arthroleptis* Smith 1849: *accraensis* (Ahl) 1923; *adolfi-friederici* Nieden 1910 (2r); *albolabris* (Ahl) 1923; *batesii* Boulenger 1906; *bequaerti* Barbour and Loveridge 1929; *bicolor* (Hewitt) 1926 (2r); *brevipalmatus* (Ahl) 1923; *calcaratus* (Peters) 1863; *carquejai* Ferreira 1906; *congicus* (Ahl) 1923; *consculum* Angel 1950; *cornutus* Boulenger 1906; *dalenei* Hoffman 1940; *dispar* Peters 1870; *elberti* (Ahl) 1923; *feae* Boulenger 1906; *fraterculus* Chabanaud 1921; *gutturosus* Chabanaud 1921; *hewitti* FitzSimons 1947 (2r); *lameerei* deWitte 1921; *lightfooti* Boulenger 1910; *loveridgei* deWitte 1933; *manengoubensis* Angel 1940; *milleti-horsini* Angel 1922; *moorii* Boulenger 1898; *nanus* (Ahl) 1923; *nimbaense* Angel 1950; *parvulus* Boulenger 1905; *poecilonotus* Peters 1863; *procterae* deWitte 1921; *pygmaeus* Ahl 1923; *pyrrhoscelis* Laurent 1952; *reichei* Nieden 1910; *scapularis* deWitte 1933; *sciangallarum* Scortecci 1943; *schoutedeni* deWitte 1921; *spinalis* Boulenger 1919; *stenodactylus* Pfeffer 1893 (2r); *sternfeldi* Ahl 1923; *taeniatus* Boulenger 1906; *tokba* Chabanaud 1921; *wageri* FitzSimons 1930; *wahlbergii* Smith 1849; *werneri* Nieden 1910; *xenochirus* Boulenger 1905; *xenodactyloides* Hewitt 1933 (3r); *xenodactylus* Boulenger 1909; *zavattarii* Scortecci 1943; *zimmeri* (Ahl) 1923.

*Astylosternus* Werner 1898: *diadematus* Werner 1898; *occidentalis* Parker 1931.

*Cacosternum* Boulenger 1887: *boettgeri* (Boulenger) 1882 (2r); *capense* Hewitt 1925; *leleupi* Laurent 1950; *platys* Rose 1950; *striatus* FitzSimons 1947.

*Cardioglossa* Boulenger 1900: *decorata* Barbour and Loveridge 1927; *dorsalis* (Peters) 1875; *elegans* Boulenger 1906; *escalerae* Boulenger 1903; *gracilis* Boulenger 1900; *leucomystax* (Boulenger) 1903; *liberiensis* Barbour and Loveridge 1927; *nigromaculata* Nieden 1908 (3r).

*Dimorphognathus* Boulenger 1906: *africanus* (Hallowell) 1857.

*Gampsosteonyx* Boulenger 1900: *batesi* Boulenger 1900.

*Hemisus* Günther 1858: *guttatum* (Rapp) 1842; *marmoratum* (Peters) 1855.

*Leptodactylodon* Andersson 1903: *albiventris* (Boulenger) 1905; *boulengeri* Nieden 1910; *ovatus* Andersson 1903 (2r); *ventrimaculata* (Nieden) 1908.

*Nyctibates* Boulenger 1904; *corrugatus* Boulenger 1904.

*Petropedetes* Reichenow 1874: *cameronensis* Reichenow 1874; *johnstoni* (Boulenger) 1887; *natator* Boulenger 1905; *newtonii* (Bocage) 1895; *palmipes* Boulenger 1905; ?*obscurus* Ahl 1923.

*Phrynobatrachus* Günther 1862: *acridoides* (Cope) 1867; *acutirostris* Nieden 1912; *aelleni* Loveridge 1955; *albomarginatus* deWitte 1933; *alleni* Parker 1936; *asper* Laurent 1951; *bonebergi* (Hewitt and Methuen)

1913; *bottegi* Boulenger 1895; *broomi* FitzSimons 1948; *capensis* Boulenger 1910; *dalcqi* Laurent 1952; *dendrobates* (Boulenger) 1919; *duckeri* Loveridge 1953; *francisci* Boulenger 1912; *gastoni* Barbour and Loveridge 1928; *giorgii* deWitte 1921; *graueri* (Nieden) 1910; *keniensis* Barbour and Loveridge 1928; *kinangopensis* Angel 1924; *krefftii* Boulenger 1909; *latifrons* Ahl 1924; *lawrencei* FitzSimons 1947; *liberiensis* Barbour and Loveridge 1927; *maculatus* FitzSimons 1932; *minutus* Boulenger 1895; *mondodi* deWitte 1930; *natalensis* (Smith) 1849; *ogoensis* (Boulenger) 1906 (2r); *pakenhami* Loveridge 1941; *parkeri* deWitte 1933; *parogoensis* Loveridge 1955; *perpalmatus* Boulenger 1898 (2r); *plicatus* (Günther) 1858; *rungwensis* (Loveridge) 1932; *rouxi* (Nieden) 1912; *steindachneri* Nieden 1910; *sulfureogularis* Laurent 1951; *tellinii* Peracca 1904; *ukingensis* Loveridge 1932 (3r); *versicolor* Ahl 1924; *vogti* Ahl 1924.

*Phrynodon* Parker 1935: *sandersoni* Parker 1935.

*Pseudohemisus* Mocquard 1895: *brevis* (Boulenger) 1896; *calcaratus* (Mocquard) 1895; *granulosus* Guibé 1952; *longimanus* Angel 1930 (2r); *madagascariensis* (Boulenger) 1882; *obscurus* (Grandidier) 1872; *pustulosus* Angel and Guibé 1945; *verrucosus* Angel 1930.

*Rana* Linnaeus 1758: *adspersa* (Duméril and Bibron) 1841 (2r); *aequiplicata* Werner 1898; *albolabris* Hallowell 1856 (2r); *ansorgii* Boulenger 1905; *beccarii* Boulenger 1911; *bibronii* Hallowell 1845; *budgetti* Boulenger 1903; *buneli* Monard 1937; *bunoderma* Boulenger 1907; *christyi* Boulenger 1919; *chrysogaster* (Laurent) 1954; *cimmarutai* Scortecci 1932; *cooperi* Parker 1930; *cordofana* (Steindachner) 1869; *cornii* Scortecci 1929; *crassipes* Buchholz and Peters 1875; *darlingi* Boulenger 1902; *delalandii* (Duméril and Bibron) 1841; *demarchii* Scortecci 1929; *draconensis* FitzSimons 1948; *elegans* Boulenger 1882; *fasciata* Duméril and Bibron 1841 (3r); *floweri* Boulenger 1917; *frontalis* (Laurent) 1954; *fuscigula* Duméril and Bibron 1841 (3r); *galamensis* Duméril and Bibron 1841 (2r); *goliath* Boulenger 1906; *gondokorensis* Werner 1907; *grandisonae* (Laurent) 1954; *grayii* Smith 1849 (2r); *griaulei* Angel 1934; *hymenopus* Boulenger 1920; *johnstoni* Günther 1893; *katangae* deWitte 1921; *keilingi* Monard 1937; *lemairei* deWitte 1921; *longirostris* Peters 1870; *loveridgei* (Laurent) 1954; *maccarthyensis* Andersson 1937; *mascareniensis* Duméril and Bibron 1841 (3r); *miotympanum* Boulenger 1919; *moeruensis* Boulenger 1901; *natalensis* (Smith) 1849; *neumani* Ahl 1923; *niedeni* Parker 1936; *obtusus* FitzSimons 1930; *occipitalis* Günther 1858; *ornata* (Peters) 1878; *ornatissima* Bocage 1879; *oxyrhynchus* Smith 1849 (3r); *pondoensis* (Power) 1935; *pumilio* Boulenger 1920; *reiensis* Monard 1951; *retropunctata* Angel 1949; *ridibunda* Pallas 1771 (3r); *ruddi* Boulenger 1907; *schillukorum* Werner 1907; *stenocephala* Boulenger 1901; *submascareniensis* Guibé and Lamotte 1953; *subpunctata* Bocage 1895; *subsigillata* Duméril 1856; *superciliaris* Günther 1858; *taenioscelis* (Laurent) 1954; *tournieri* Guibé and Lamotte 1956; *trinodis* Boettger 1881 (2r); *tuberculosa* (Günther) 1858; *umbraculata* Bush 1952; *vertebralis* Hewitt

1927; *wittei* (Angel) 1924; *zavattari* Scortecci 1936; *zenkeri* Nieden 1908.

*Scaphiophryne* Boulenger 1882: *marmorata* Boulenger 1882.

*Schoutedenella* deWitte 1921: *discodactyla* Laurent 1954; *globosa* deWitte 1921 (2r); *hematogaster* Laurent 1954; *kivuensis* deWitte 1941; *mossoensis* Laurent 1954; *muta* deWitte 1933; *vercammeni* Laurent 1954.

*Scotobleps* Boulenger 1900: *gabonicus* Boulenger 1900.

*Trichobatrachus* Boulenger 1900: *robustus* Boulenger 1900.

RHACOPHORIDAE

*Afrixalus* Laurent 1944: *betsileo* (Grandidier) 1872; *boettgeri* (Mocquard) 1902; *brachycnemis* (Boulenger) 1896 ((2r); *fornasinii* (Bianconi) 1850 (4r); *immaculatus* (Boulenger) 1903; *laevis* (Ahl) 1930; *leucostictus* Laurent 1950; *lindholmi* (Andersson) 1907; *maculifer* (Ahl) 1924; *madagascariensis* (Duméril and Bibron) 1841; *mocquardi* (Boettger) 1913; *orophilus* Laurent 1947; *parkeri* (Scortecci) 1933 (2r); *renifer* (Boettger) 1881; *spinosus* (Buchholz and Peters) 1875; *stuhlmanni* (Pfeffer) 1893; *tricolor* (Boettger) 1881; *uluguruensis* (Barbour and Loveridge) 1928; *variabilis* (Ahl) 1930; *weidholzi* (Mertens) 1938; *wittei* (Laurent) 1941.

*Callixalus* Laurent 1950: *pictus* Laurent 1950.

*Chiromantis* Peters 1855: *microglossus* Ahl 1929; *petersii* Boulenger 1882 (2r); *rufescens* (Günther) 1868; *xerampelina* Peters 1855.

*Chrysobatrachus* Laurent 1951: *cupreonitens* Laurent 1951.

*Dendrobatorana* Ahl 1927: *dorsalis* (Peters) 1875.

*Gephyromantis* Methuen 1920: *albogularis* Guibé 1947; *bertini* Guibé 1947; *boulengeri* Methuen 1920; *decaryi* Angel 1930 (2r); *methueni* Angel 1929; *tricinctus* Guibé 1947; *verrucosus* Angel 1930.

*Hylambates* Duméril 1858: *cassinoides* Boulenger 1903; *cochranae* Loveridge 1941; *greshoffii* Schilthuis 1889; *lebeaui* deWitte 1933; *leonardi* Boulenger 1906; *maculatus* Duméril 1853; *ragazzii* Boulenger 1896; *verrucosus* Boulenger 1912.

*Hyperolius* Rapp 1842: *acuticephalus* Ahl 1931; *acutirostris* Peters 1875; *adametzi* Ahl 1931; *adspersus* Peters 1877; *albifrons* Ahl 1931; *albofasciatus* Hoffman 1944; *albofrenatus* Ahl 1931; *albolabris* Ahl 1931; *angolanus* Ahl 1931; *angolensis* Steindachner 1867 (2r); *argentophthalmus* Ahl 1931; *argentovittis* Ahl 1931; *argus* Peters 1855; *atrigularis* Laurent 1941; *aylmeri* (Boulenger) 1915; *balfouri* (Werner) 1907; *baumanni* Ahl 1931; *bayoni* (Boulenger) 1911; *benguellensis* (Bocage) 1893; *benueensis* Monard 1951; *bergeri* Ahl 1931; *bicolor* Ahl 1931; *bitaeniatus* Ahl 1931; *bocagei* Steindachner 1867; *bolifambae* Mertens 1938; *boulengeri* Laurent 1943; *brachiofasciatus* Ahl 1931; *buchholzi* Ahl 1931; *burtonii* (Boulenger) 1883; *callichromus* Ahl 1931; *castaneus* Ahl 1931 (3r); *chabanaudi* Ahl 1931; *chlorosteus* (Boulenger) 1915; *chrysogaster* Laurent 1950; ?*cinctiventris* Cope 1862; *cinereus* Monard

1937; *cinnamomeiventris* Bocage 1866; *concolor* (Hallowell) 1844 (3r); *decipiens* Ahl 1931; *decoratus* Ahl 1931; *depressus* Ahl 1931; *dermatus* Ahl 1931; *destefanii* Scortecci 1943; *discodactylus* Ahl 1931; *erythrodactylus* Guibé 1953; *erythropus* Laurent 1943; *fasciatus* (Ferreira) 1906; *ferreirai* Noble 1924; *ferrugineus* Laurent 1943; *festivus* Barbour and Loveridge 1927; *fimbriolatus* Peters 1876; *flavoguttatus* Ahl 1931; *friedrichsi* Ahl 1930; *frontalis* Laurent 1950; *fuelleborni* Ahl 1931; *fulvovittatus* Cope 1861 (2r); *fusciventris* Peters 1876; *ghesquieri* Laurent 1943; *glandicolor* Peters 1878; *goetzei* Ahl 1931; *guineensis* Ahl 1931; *gularis* Ahl 1931; *guttulatus* Günther 1858; *guttatus* Peters 1875; *heuglini* Steindachner 1864; *hieroglyphicus* Ahl 1931; *horstockii* (Schlegel) 1837-1844 (2r); *houyi* Ahl 1931; *huillensis* Bocage 1873; *idae* Steindachner 1867; *ituriensis* Laurent 1943; *kibarae* Laurent 1957; *kivuensis* Ahl 1931 (2r); *knysnae* Loveridge 1954; *kohleri* Mertens 1940; *krebsi* Mertens 1938; *lagoensis* (Günther) 1868; *langi* Noble 1924; *lateralis* Laurent 1940 (9r); *laticeps* Ahl 1931; *latifrons* Ahl 1931; *leleupi* Laurent 1951; *leucotaenius* Laurent 1950 (2r); *liberiensis* Laurent 1951; *lucani* Rochebrune 1885; *machadoi* Laurent 1941; *maestus* Rochebrune 1885; *marginatus* Peters 1854; *mariae* Barbour and Loveridge 1928; *marmoratus* Rapp 1842 (? 20r); *molleri* (Bedriaga) 1892; *montanus* (Angel) 1924; *mossambicus* Parker 1930; *multicolor* Ahl 1931; *narinus* Ahl 1931; *nasutus* Günther 1864 (2r); *nigropalmatus* Ahl 1931; *nossibeensis* Ahl 1930; *obscurus* Laurent 1943; *obstetricans* Ahl 1931; *ocellatus* Günther 1858; *oeseri* Ahl 1931; *osorioi* (Ferreira) 1906; *pallidus* Mertens 1940; *pantherinus* (Steindachner) 1891; *papyri* (Werner) 1907; *parkeri* Loveridge 1933 (2r); *pauliani* Guibé 1953; *phantasticus* (Boulenger) 1899; *picturatus* Peters 1875; *platyceps* (Boulenger) 1900 (3r); *pleurotaenius* (Boulenger) 1906; *polli* Laurent 1943; *polystictus* Laurent 1943; *poweri* Loveridge 1938; *protchei* Rochebrune 1885; *pulcher* Ahl 1931; *punctatissimus* Ahl 1931; *puncticulatus* (Pfeffer) 1893 (3r); *pusillus* (Cope) 1862; *pustulifer* Laurent 1940; *quadratomaculatus* Ahl 1931; *quinquevittatus* Bocage 1866; *raveni* Ahl 1931; *reticulatus* Günther 1864; *rhizophilus* Rochebrune 1885; *rhodoscelis* (Boulenger) 1901; *riggenbachi* (Nieden) 1910; *rosaceus* Ahl 1931; *rutenbergi* Boettger 1881; *salinae* (Bianconi) 1848; *schoutedeni* Laurent 1943; *schubotzi* Ahl 1931 (2r); *scriptus* Ahl 1931; *seabrai* (Ferreira) 1906; *soror* (Chabanaud) 1921; *spatzi* Ahl 1931; *steindachneri* Bocage 1866 (2r); *stenodactylus* Ahl 1931; *striolatus* Peters 1882; *thomensis* Bocage 1886; *thoracotuberculatus* Ahl 1931; *togoensis* Ahl 1931; *tornieri* Ahl 1931; *trifasciatus* Ahl 1931; *tuberculatus* (Mocquard) 1897 (2r); *udjidjiensis* Ahl 1931; *variabilis* Ahl 1931; *ventrimaculatus* Ahl 1931; *vermicularis* Ahl 1931; *vermiculatus* Peters 1882; *viridiflavus* (Duméril and Bibron) 1841 (? 12r); *zavattarii* Scortecci 1943.

*Kassina* Girard 1853: *benueana* Monard 1951; *decoratus* (Angel) 1940; *kwangensis* (Monard) 1937; *maculata* Parker 1931; *pulchra* (Ahl)

1924; *senegalensis* (Duméril and Bibron) 1841 (2r); *thabanchuensis* (Hoffman) 1939; *wealii* (Boulenger) 1882 (3r).

*Leptopelis* Günther 1858: *acuticeps* Ahl 1929; *anchietae* (Bocage) 1873; *argenteus* (Pfeffer) 1893; *aubryi* (Duméril) 1856; *bequaerti* Loveridge 1941; *bocagii* (Günther) 1864; *boulengeri* (Werner) 1898; *brevipes* (Boulenger) 1906; *brevirostris* (Werner) 1898; *buchholzi* Ahl 1929; *calcaratus* (Boulenger) 1906; *concolor* Ahl 1929; *flaviventer* Ahl 1929; *flavomaculatus* (Günther) 1864; *gramineus* (Boulenger) 1898; *guineensis* Ahl 1929; *haugi* (Mocquard) 1902; *hyloides* (Boulenger) 1906; *jordani* Parker 1936; *karissimbensis* Ahl 1929; *millsoni* (Boulenger) 1894; *modestus* (Werner) 1898; *nanus* Ahl 1923; *natalensis* (Smith) 1849; *notatus* (Peters) 1875; *ocellatus* (Mocquard) 1902; *palmatus* (Peters) 1868; *parkeri* Barbour and Loveridge 1928; *poensis* Ahl 1929; *rugosus* (Ahl) 1924; *tessmanni* (Nieden) 1909; *togoensis* Ahl 1929; *uluguruensis* Barbour and Loveridge 1928; *vannutellii* (Boulenger) 1898; *vermiculatus* (Boulenger) 1897; *violescens* Ahl 1929; *viridis* (Günther) 1868.

*Mantella* Boulenger 1882: *attemsi* Werner 1901; *aurantiaca* Mocquard 1900; *baroni* Boulenger 1888; *betsileo* (Grandidier) 1872; *cowanii* Boulenger 1882; *ebenaui* (Boettger) 1880; *laevigata* Methuen and Hewitt 1913; *loppei* Roux 1936; *madagascariensis* (Grandidier) 1872; *pulchra* Parker 1925.

*Mantidactylus* Boulenger 1895: *acuticeps* Ahl 1929; *aerumnalis* (Peracca) 1893; *albofrenatus* (Müller) 1892; *alutus* (Peracca) 1893; *ambohimitombi* Boulenger 1918; *argenteus* Methuen 1920; *asper* (Boulenger) 1882; *bellyi* Mocquard 1895; *betsileanus* (Boulenger) 1882; *biporus* (Boulenger) 1889; *brauni* Ahl 1929; *brevipalmatus* Ahl 1929; *brunneus* Ahl 1929; *catalai* Angel 1935; *ceratophrys* Ahl 1929; *curtus* (Boulenger) 1882; *delormei* Angel 1938; *femoralis* (Boulenger) 1882; *flavicrus* (Boulenger) 1889; *frenatus* Boettger 1913; *glandulosus* Methuen and Hewitt 1913; *grandidieri* Mocquard 1895; *granulatus* (Boettger) 1881; *guttulatus* (Boulenger) 1881; *inaudax* (Peracca) 1893; *laevis* Angel 1929; *lugubris* (Duméril) 1853; *luteus* Methuen and Hewitt 1913; *madagascariensis* (Duméril) 1853; *majori* Boulenger 1896; *microtympanum* Angel 1935; *mocquardi* Angel 1929; *opiparis* (Peracca) 1893; *pliciferus* (Boulenger) 1882; *poissoni* Angel 1937; *purpureus* Ahl 1929; *redimitus* (Boulenger) 1889; *sculpturatus* Ahl 1929; *tripunctatus* Angel 1930; *ulcerosus* (Boettger) 1880.

*Megalixalus* Günther 1868: *seychellensis* (Tschudi) 1838.

*Mocquardia* Ahl 1931: *abyssinica* (Parker) 1930; *obscura* (Boulenger) 1894.

*Rhacophorus* Kuhl 1827: *albilabris* Boulenger 1888; *albiventer* Ahl 1929; *anceps* Mocquard 1902; *andringitrensis* Millot and Guibé 1950; *arboreus* Ahl 1928; *bicalcaratus* Boettger 1913; *boettgeri* Boulenger 1882; *boulengeri* Peracca 1892; *brevirostris* Ahl 1928; *callichromus* Ahl 1928; *crossleyi* (Peters) 1874; *difficilis* Boettger 1892; *fasciolatus* Ahl 1929; *goudoti* (Tschudi) 1838; *herthae* Ahl 1929; *hildebrandti* Ahl 1925;

*hyloides* Ahl 1929; *isabellinus* Boettger 1913; *laurenti* (Guibé) 1947; *liber* Peracca 1893; *luteus* Boulenger 1882; *madagascariensis* Peters 1874; *madecassus* Millot and Guibé 1950; *majori* Boulenger 1896; *miniatus* Mocquard 1902; *mocquardti* Boulenger 1896; *obscurus* Boettger 1913; *opisthodon* Boulenger 1888; *peraccae* Boulenger 1896; *pulcher* Boulenger 1882; *rappiodes* Ahl 1928; *rhodoscelis* Boulenger 1882; *sikorae* Boettger 1913; *tephraeomystax* (Duméril) 1853; *untersteini* Ahl 1928; *webbi* Grandison 1953.

*Trachymantis* Methuen 1920: *horridus* (Boettger) 1880; *malagasia* (Methuen and Hewitt) 1913.

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# REPORT OF COUNCIL
# THE EIGHTY-FOURTH ANNUAL MEETING OF THE OTTAWA FIELD-NATURALISTS' CLUB

December 4, 1962

There were six meetings of the Council during the year at the National Museum on: December 12, 1961, January 4, February 27, May 8, October 4 and November 15, 1962, with an average attendance of 13 Council members. The usual club business was conducted by your Council in an orderly fashion.

Appointments of the 1962 officers were made as follows:

Editor, CANADIAN FIELD-NATURALIST —
R. A. HAMILTON succeeded by F. R. COOK, February 27, 1962
Business Manager, CANADIAN FIELD-NATURALIST — W. J. CODY
Chairman, Publications Committee — D. D. HOGARTH
Chairman, Excursions and Lectures Committee — A. H. CLARKE, JR.
Chairman, Reserve Fund Committee — H. LLOYD
Chairman, Membership Committee — R. J. MOORE
Chairman, Bird Census Committee — G. R. HANES
Chairman, Macoun Field Club Committee — F. R. COOK
Chairman, F.O.N. Affairs Committee — D. A. SMITH
Chairman, Public Relations Committee — E. L. BOUSFIELD
Chairman, Preservation Historic Sites Committee — W. K. W. BALDWIN

## REPORT OF THE PUBLICATIONS COMMITTEE

Upon the completion of Volume 75, Robert A. Hamilton, who had served as editor of THE CANADIAN FIELD-NATURALIST for six years, turned the duties of that office over to our new editor, Francis R. Cook. The Committee was most appreciative of the fine job which Mr. Hamilton had done in editing the Journal during a difficult period.

In 1962 two numbers of Volume 76 of THE CANADIAN FIELD-NATURALIST have been published. These two issues comprised 126 pages in all. Papers, notes and reviews were distributed as follows:

| | | | |
|---|---|---|---|
| Botany | 2 | 3 | 3 |
| Geology | 2 | | |
| Herpetology | 2 | | |
| Ichthyology | | 1 | 1 |
| Malacology | | 1 | |
| Mammalogy | 4 | | |
| Ornitholgoy | 2 | 6 | 1 |
| Miscellaneous | | | 2 |
| | 12 | 11 | 7 |

Numbers 3 and 4 of Volume 76 have not appeared because of the editor's absence in the field and subsequent illness. Both are now in an advanced state of preparation and should be published shortly after the annual meeting.

The editor has reported to the Committee that papers accepted for publication have nearly all been set in type for numbers 3 and 4 of Volume 76.

Manuscripts suitable for publication could therefore be published quickly in subsequent numbers.

The Committee has approved accounts totalling $5,007.55. This was for Volume 75, No. 4, and Volume 76, Nos. 1 and 2 ($3,763.33) and the reprints for Volume 75, Nos. 3 and 4 and Volume 76, No. 1 ($1,244.22). The latter amount has been or will be recovered from authors in the sale of the reprints as will the cost of plates which is included in the cost of the Journal issues.

The publication of THE CANADIAN FIELD-NATURALIST was again materially assisted this year by a grant of $500 from the Conservation Council of Ontario. This assistance is gratefully acknowledged.

### REPORT OF THE EXCURSIONS AND LECTURES COMMITTEE

During 1962, the Excursions and Lectures Committee arranged four lecture-and-workshop meetings, five nature study excursions, one nature film (co-sponsored with the National Museum), two lecture-and-discussion meetings, four bird walks and the annual dinner.

Attendance at these functions has been erratic: from thirty to one hundred people attended the meetings while the excursions attracted groups varying between five and thirty.

The Annual Dinner was attended by approximately seventy-five persons. The speaker, Mr. Donald A. Smith, gave an entertaining and instructive lecture entitled "Glimpses of Timberline and Tundra".

Lecturers at the monthly meetings were Messrs. A. H. Clarke, Jr., J. A. Downes, J. M. Gillett, F. R. Cook, A. W. F. Banfield and D. J. Crisp. The four monthly meetings in the spring included workshops on geology, botany, invertebrates, and vertebrates at each meeting. The workshops which had in part fulfilled their function of stimulating original investigation of the local fauna and flora, were replaced in the fall with informal discussion periods.

Excursion leaders and topics emphasized were: G. R. Hanes, bird hike; J. M. Gillett, spring spring flowers; D. Hogarth, rare minerals of the Gatineau; A. H. Clarke, Jr., freshwater mollusk collecting; and J. M. Gillett, general. Leaders of the morning bird walks were: D. A. Smith, D. B. O. Savile, W. E. Godfrey, and G. R. Hanes. The nature film shown on May 16, was entitled "Sea-Bird Summer" and was truly outstanding.

### REPORT OF THE RESERVE FUND COMMITTEE

There was no change in the Reserve Fund's investments during the year. Twenty Bell Telephone rights were received and sold. Attention of the new Council is called to the desirability of a modest increase in investments as soon as conditions warrant.

### REPORT OF THE MEMBERSHIP COMMITTEE

After consulting Committee members by letter and by phone, the chairman composed a revised leaflet soliciting new members. With the assistance of the Committee, the circular was distributed locally through personal contacts and left in public libraries and in the National Museum. Ten persons have made application for membership (8 active, 2 associate memberships) on the attached form. Cost of printing 2,000 copies of the circular was $24.58.

### REPORT OF THE BIRD CENSUS COMMITTEE

Our forty-third Christmas Bird Census was held on December 24, 1961.

Thirty-six observers reported a record total of 48 species, surpassing the records set the previous two years of 46 and 45. No new species were seen, and so the all-time list stands at 87 species. The details were published in the Audubon Field Notes, Vol. 16, No. 2, and circulated to local members in a Newsletter.

### REPORT OF THE MACOUN FIELD CLUB COMMITTEE

Due to renovations in the Museum building, the Club did not begin 1961-62 meetings until February 16. The presidents elected for the senior, intermediate and junior groups were Elizabeth Sinclair, Cedric Pearson, and Arthur Clarke. Four of the nine spring meetings featured guest speakers. One field hike, to Hogsback, was held in May.

Due to the illness of the chairman, the Annual Birthday Party, scheduled for the fall, had to be cancelled. Inclement weather washed out scheduled field hikes. Four fall meetings have been held, two with guest speakers. Douglas Munroe, Arthur Clarke, and David Smiley are the new presidents of the senior, intermediate and junior groups. No. 20 of *The Little Bear* was distributed at the first fall meeting.

The Club's library, exhibits and study material have been arranged in new quarters on the third floor, east wing, of the National Museum. All meetings have been held in this spacious and attractive room since early March. The chairman is indebted to all those who have helped and supported the Club during the past year, but is particularly so to Mr. Herbert Groh, who has been responsible, among other contributions, both for *The Little Bear* and for the organization of the Club's collections and its library.

### REPORT OF F.O.N. AFFAIRS COMMITTEE

We received notices and reports on various events and activities sponsored by or participated in by the F.O.N.

With the co-operation of the Excursions and Lectures Committee, we distributed either at meetings or with notices various brochures on personal F.O.N. memberships, the F.O.N. Camp, Sounds of Nature Recordings, The Young Naturalists and other activities.

We co-operated with the Excursions and Lectures Committee in arranging the showings of the film "Seabird Summer", obtained through the F.O.N., on May 16 at the National Museum.

Early in 1962, we turned over to the Treasurer of the O.F.N.C. the profit of $6.75 from the sale of 27 dozen F.O.N.-published Christmas cards sold during late 1961.

Our major activity this fall has been to step up our campaign to sell the 1962 F.O.N. Christmas cards and hasti-notes. To date, orders for 134 dozen cards have been handled. An estimated profit of about $33 will be turned over to the Treasurer when all the transactions have been completed—probably in early January 1963.

### REPORT OF THE PUBLIC RELATIONS COMMITTEE

During the past year, the Commitee promoted and advertised special events of the club as requested by Council.

### REPORT OF PRESERVATION OF HISTORIC SITES COMMITTEE

The Committee was inactive most of the year.

A. W. F. BANFIELD, *Secretary*.

# STATEMENT OF FINANCIAL STANDING
# THE OTTAWA FIELD-NATURALISTS' CLUB, November 29, 1962

## CURRENT ACCOUNT

| ASSETS | | LIABILITIES | |
|---|---|---|---|
| Balance in bank Nov. 29, 1962 | $2,919.13 | Cheques outstanding | $ 50.81 |
| Bills receivable, separates | 1,093.30 | Balance | 3,961.62 |
| | $4,012.43 | | $4,012.43 |
| **RECEIPTS** | | **EXPENDITURES** | |
| Balance in bank Nov. 30, 1961 | $2,804.62 | Can. Field Nat. 3 numbers | $3,763.33 |
| Fees: | | Separates and illustrations | 1,282.65 |
| Current $2,930.28 | | Editor's honorarium 1961 | 100.00 |
| Arrears 428.15 | | Editor's honorium 1962 | 200.00 |
| Advance 377.65 | | Business Manager's honorarium | 100.00 |
| Associate 117.00 | | Excursions and Lectures Comm. | 112.66 |
| | 3,853.08 | Membership Committee | 24.58 |
| Separates and illustrations | 1,297.39 | F.O.N. affiliation | 50.00 |
| Sale of back numbers | 357.10 | Postage and stationery | 254.16 |
| Donations: | | Bank discount | 29.95 |
| Conservation Council, Ontario $ 500.00 | | Miscellaneous | 136.97 |
| H. A. C. Jackson gifts 10.00 | | Bank balance Nov. 29, 1962 | |
| Affiliate societies 7.50 | | $2,919.13 less $50.81 o/s cheques | 2,868.32 |
| | 517.50 | | |
| Miscellaneous | 92.93 | | |
| | $8,922.62 | | $8,922.62 |

## RESERVE FUND

| ASSETS | | LIABILITIES |
|---|---|---|
| $3,000 Ontario Hydro 3% bonds, market value | $2,670.00 | |
| 20 shares Bell Telephone stock market value | 1,010.00 | NIL |
| Balance in bank Nov. 29, 1962 | 273.77 | |
| | $3,953.77 | |

| RECEIPTS | | EXPENDITURES | |
|---|---|---|---|
| Balance in bank Nov. 30, 1961 | $ 125.94 | Safety deposit box | $ 5.00 |
| Bank interest | 3.83 | Bank balance Nov. 29, 1962 | 273.77 |
| Bond interest | 90.00 | | |
| Dividends, Bell Telephone | 44.00 | | |
| Sale of rights, Bell Telephone | 15.00 | | |
| | $ 278.77 | | $ 278.77 |

## PUBLICATIONS FUND

| ASSETS | | LIABILITIES |
|---|---|---|
| $1,500 Ontario Hydro 3% bonds, market value | $1,335.00 | |
| Bank balance, Nov. 29, 1962 | 240.72 | NIL |
| | $1,575.72 | |

| RECEIPTS | | EXPENDITURES | |
|---|---|---|---|
| Bank balance, Nov. 30, 1961 | $ 190.48 | Bank balance, Nov. 29, 1962 | $ 240.72 |
| Bank interest | 5.24 | | |
| Bond interest | 45.00 | | |
| | $ 240.72 | | $ 240.72 |

(Signed) Anne Banning, Treasurer
Audited and found correct, November 29, 1962
(Signed) R. J. Moore
J. M. Gillett, Auditors

# REVIEWS

**Animal Dispersion in Relation to Social Behaviour**

By V. C. Wynne-Edwards. Oliver and Boyd, Edinburgh and London. 1962. *xi* + 653 p., XI pl. 55s.

The title of this book may be misleading to many biologist readers. It should be explained that by dispersal the author means population density. This monographic study is in the field of animal population dynamics. Dr. Wynne-Edwards expounds his theory of the fundamental importance of social organization as a population control mechanism in the first chapter and then amasses an impressive array of evidence to support his theory and its widespread ramifications, in the succeeding twenty-two chapters.

The author starts with two basic assumptions. Firstly, most animal populations are ultimately limited by their food resources. Ideally the habitat should carry the optimum density related to its productivity, so as not to cause over exploitation of the resources, the destruction of the habitat and the starvation of the inhabitants. Secondly, that it is advantageous to animal species to develop self-limiting population control mechanisms to keep their densities near the optimum for the habitat they occupy (homeostasis).

Social organization provides an ideal feed-back mechanism to adjust population levels to the resources and so serve as such a homeostatic machine. An overt contest for food inevitably leads to over-exploitation and ruination, but the substitution of competition for conventional goals such as territorial rights, or social hierarchy will act to control populations at the optimum level and thus conserve the resources.

Darwin first showed how natural selection operated on two levels: (a) on the individual's adaptations to its environment and (b) on the species in competition with other species in the common habitat. Wynne-Edwards, however, emphasizes group selection – the natural selection of groups which have evolved adequate population homeostatic machinery. It is important to note that in an effective social hierarchy the interests of the individual are suppressed, for the benefit of the unit.

Whatever reservations one might have for Dr. Wynne-Edwards' theory after chapter one, they are gradually overwhelmed by the weight of observations which the author has collected from many fields of zoology to support his hypothesis. His succeeding chapters deal with social integration by visible signals, sound, electric signals, olfactory signals and tactile perception, the social group and the status of the individual, dispersion, property-tenure, communal displays, castes, communal roosts, the use of tradition, siblings and mimics, fluctuations, irruptions and emigrations, recruitment and socially induced mortality.

The author early disarms possible critics by admitting that environmental factors such as nesting holes, breeding ponds and weather may occasionally act as population-limiting factors, but he maintains the fundamental importance of food. The author draws most of his examples from ornithology, and admits that his layman's interest in some other fields may have led him to draw some false conclusions. Such unfamiliarity with the group must account for his statement on page 596: "and the rodents have dispensed with tooth-replacement altogether, having only a single set that grow 'by the yard' as required as long as the animal lives", which is an unwarranted generalization. Specialists may find other questionable statements in their fields, but I believe that there will be remarkably few.

An interesting facet of the book is the treatment of man's conventional behaviour, which is shown to be unexpectedly close to his fellow animals', particularly the social behaviour of primitive man. With the evolution of 'civilized' man and his associated behavioural patterns in historic times, we see the loss of the self-limiting population mechanisms which primitive man shared with the other animals. With this background the catastrophic human population explosion now taking place assumes new significance.

The author assumes considerable responsibility for the originality of the theory outlined in the book. This does not seem to be strictly true: many other researchers in the field of population dynamics have recognized the important role of social behaviour as a self-regulatory population mechanism. Such conclusions may be found in the reports of Thomas Park, Olavi Kalela and others. Perhaps no clearer statement can be found than that of J. A. King (1955, Contributions of the Laboratory of Vertebrate Biology, University of Michigan 67) writing of the social organization and population dynamics of a prairie dog town: "The social behavior of prairie dogs, including the defence of coterie territories, is a mechanism which regulates their local population density". However, Wynne-Edwards has done a masterful job of collating the evidence and expounding the central theory and so this work will undoubtedly take its place as the classic monograph on the subject.

Canadian readers will recall with pleasure that Dr. Wynne-Edwards served as Associate Professor of Zoology at McGill University from 1930 to 1946 and many of his examples are chosen from his Canadian experience.

A. W. F. BANFIELD

**Introduction to Mammalogy**
By E. LENDELL COCKRUM. The Ronald Press Company, N.Y. 1962. 455 pp. $9.00.

A number of universities teach courses in mammalogy. Until the appearance of this volume there has been no general textbook available for such a course.

According to the introduction this book was "designed as a textbook for courses in mammalogy and wildlife management." Its two parts cover (part one) "basic principles relating to all mammals, including characteristics, classification, distribution, reproduction, development, behavior, populations and economic relationships", and (part two) "a discussion in systematic order of each of the 123 families of living mammals".

Part one fills only about one-quarter of the book; therefore, the coverage of each subject is brief. No new information is presented; however, considerable basic literature is briefly summarized.

Part two gives characteristics, range and natural history of the orders and families. The recent genera are listed with an indication of their distribution. There are distribution maps of each recent family of mammals with the exception of the seals and whales. Some species are illustrated by photographs.

I find that this book fills its purpose as a text in neomammalogy fairly well. The large number of references to the literature should stimulate students to dig into the libraries for themselves. However, the relatively few references in languages other than English will do little to broaden the generally provincial scope of North American mammalogy.

The drawings leave a great deal to be desired, and the inclusion of two or more families on one range map is often confusing. The photographs are generally good, but too often the well known species are included while the reader is left to speculate on the appearance of mammals with such intriguing names as tucu-tucu, huitia, spring haas, and aye-aye.

Six pages and nine references are given to a discussion of the origin of the mammalian molar while mammalian evolution is dismissed in about four pages without a single reference.

Examples of some relatively minor faults are the lack of a discussion of introduced mammals, the omission of the source of progesterone (p. 75), and at least one reference (p. 75) not included in the Literature Cited. These, however, detract little from the overall value of the book.

PHILLIP M. YOUNGMAN
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**The Natural World of Louise Dickinson Rich**

By LOUISE DICKINSON RICH. 1962. Dodd, Mead and Company, New York. 195 pp.

The introduction to this volume of natural history reminiscences of New England from the pen of Louise Dickinson Rich quickly sets its approach and mood. The author, as she readily asserts, is one of the legion "... who are called — sometimes scornfully, sometimes with amused patronage — nature lovers and bird watchers . . . .

"These people are not trained scientists. They amass no statistics, propound no erudite theories, make no contribution to the body of zoological, botanical or geological knowledge . . . they tend to become amused by the marvelous and various world into which they were born and to fritter their time away in looking and listening, feeling, smelling and tasting".

Despite this eloquent and wholly justifiable defense of the casual naturalist, such meaningless terms as "field-mice", "red deer" and "hen hawk", misspellings like "whipporwill" and "shelldrake"; misuse of terms as "birds and small animals" and sweeping statements like "The passenger pigeons are gone and the toads are going", while they do serve to make the book more authentically amateur, mar sympathy toward the writer. A minimum of browsing into the contributions of "trained scientists" would have weeded out many of these and made the book more palatable. A tendency toward dogmatic sentimentality in interpreting the action of animals is perhaps more forgivable.

The book is in three sections: The Plain, The Woods, The Coast. Much of the text is entertaining reading and should have appeal for those who "love" nature and the New England countryside and who will either miss or forgive the inaccuracies. Margaret Cosgrove has admirably captured the spirit of the text with her drawings.

FRANCIS R. COOK

**Development of Behaviour in Precocial Birds**

By MARGARET MORSE NICE. *Transactions* of the Luinean Society of New York. Vol. VII 1962. 211 pp. Illustrated. $4.00.

This volume gives descriptions of the behaviour of hand reared chicks of representative precocial, semi-precocial, semi-altricial and altricial birds. In particular the ages at which particular motor coordinations first appeared, such as standing, picking up food and flying, are noted. The precocials observed were twelve species of duck, Kildeer and Spotted Sandpiper, domestic fowl, three species of grebes and three of rails. Semi-precocial birds observed were Forster's Terns and Franklin's Gulls. Semi-altricial birds were represented by the American Bittern and altricial birds by five passerine species.

It was found that twelve to thirteen day old embryos of precocial birds correspond in behavioural development to newly hatched young of altricial birds which have hatched after a twelve to thirteen day period of incubation. Also, day-old precocial birds resemble altricial birds which have left the nest for a day or two, both being at these stages at

about the same age from the start of incubation.

There is also a discussion of imprinting, aggression and play fleeing in precocial and altricial birds and certain other animals.

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**Common Seashore Animals of the Pacific Northwest**

By LYNWOOD SMITH. Naturegraph Ocean Guidebooks, Vol. 2, Naturegraph Co., Healdsburg, California. 1962. 66 pp., 85 figs., 1 pl. Paper $1.75. Cloth $3.50.

This little booklet is an introductory and elementary guide to the seashore plants and animals of the Pacific coast, from northern California to southeastern Alaska. Field identification marks for about 100 of the most conspicuous species are described, and interesting information on behavior, life history, and habitat is usually included. The author's ecological approach to the study of marine organisms is reflected by his treatment of faunal assemblages (of sand beaches, rocky shores, mud flats, wharf pilings, etc.) and of functional morphology of the diverse faunal types (i.e., how they feed and adapt to environmental conditions). He includes practical advice on the collection and preservation of specimens and on the rearing of animals in tanks and, as a conservationist, advocates turning back rocks, filling in clam holes, and otherwise protecting our beach resources from unnecessary wastage. Information on certain phyla, particularly where component species are large (Mollusca and Echinodermata), is reasonably detailed and accurate. However, his account of micro-organisms and "odds and ends of crustaceans" is very sketchy and frequently erroneous; for instance, the shore slater *Ligia* (not *Idothea*) occurs on high tide rocks, and *Anisogammarus* (not *Gammarus*) is the common amphipod of Puget Sound beaches. Although some of the line drawings and sketches of animals (e.g. *Panope*, *Cyanea*, *Pagurus*) are adequate, most are poorly done; generally they do not show diagnostic features of identification and in some instances (e.g. the beach hopper *Orchestia*) are grossly inaccurate. Sketches such as those of "Lincoln Park Beach" (p. 3) or "clam digger's hole" (p. 9) contribute little, yet take up significant space in so small a booklet. The "Appendix" and "References" are all too brief; the latter might have included useful Canadian publications such as those by Quayle (bivalve mollusks), Cornwall (barnacles), and Berkeley (polychaete worms). The addition of a misprinted color plate of representative invertebrates scarcely justifies the relatively high cost of this inexpensively produced booklet; for double the money the layman and student might be well advised to purchase Ricketts and Calvin (1952) or other comprehensive regional reference works suggested by the author.

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**Subantarctic Campbell Island**

By ALFRED M. BAILEY AND J. H. SORENSEN. Proceedings No. 10, Denver Museum of Natural History. 1962. 305 pages.

This lavishly produced volume forms a notable addition to the literature of subantarctic islands. It was conceived after the Denver Museum's subantarctic expedition, but it can scarcely be called a product of that expedition which, in a period of six weeks on Campbell Island in early 1958, was concerned primarily with collecting specimens of the birds and mammals for display. As Dr. Bailey, the Director of the Denver Museum, is at pains to point out in a foreword, the observations on which the book is based are drawn mainly from the published work and field notes of his New Zealand collaborator, Mr. Sorensen, and other New Zealanders since 1941. The book is

mainly concerned with bird life, but to justify the title the authors provide chapters on the early history of the island, the geology, the flora and the mammals.

Campbell Island lies between latitudes 52° and 53°S., or about 400 miles south of New Zealand, and has an area of about forty square miles; its nearest neighbours are Auckland Island about 200 miles to the northwest, and Macquarie Island more than 400 miles to the southwest. Lying in the path of the Roaring Forties or Howling Fifties, subantarctic islands in general have a climate which is marked by savage storms, a very high proportion of days with rain, and a low incidence of sunshine. Campbell Island is no exception; the weather conditions in the authors' words are "unpredictable", although the temperature range about a mean annual value of 44°F. is not great. The subantarctic climate, although very inhospitable to man, is not killing; it is perhaps best described as marginal for human settlement. On the other hand, the southern ocean for all its storminess supports a prolific mammal and avian fauna. The isolation of the subantarctic islands has led to the endemism of certain plant and animal species, to the absence of native land mammals (with the single exception of the now extinct Falkland Island Fox), and to an ecological balance which is easily upset by the introduction of foreign elements. Here then are some of the factors which give these islands their peculiar interest to the biologist and the geographer. In the light of these factors, how far have the present authors succeeded in portraying the environment and wild life of a typical subantarctic island?

From its discovery in 1810 by the captain of a sealing ship until the Second World War, Campbell Island had a checkered history marked by shipwrecks, ruthless exploitation of the animal life and an ill-fated attempt at sheep-farming. Several scientific expeditions visited the island during this period. The story of the slaughter of seals and penguins on Campbell and other islands is shocking, but the seal hunters were hardy men who lived dangerously, and men who wrest a living in stern surroundings were never noted for their respect for life. Sheep-farming was finally abandoned in 1931 after more than thirty years of struggle against bad weather, difficult terrain and great distance from market. (We may note that the story of sheep-farming on the Kerguelen Islands is similar, and that only the Falkland Islands and Tristan da Cunha of the subantarctic islands have been successfully settled by man). During the war, the island was occupied by a coast-watching party from 1941-45 (the Cape Expedition), and latterly a meteorological station has been maintained on the island by the New Zealand Air Department. Work has been strictly scientific, but the earlier visitors had already left their mark on the fauna and flora by their activities, including the introduction of domestic animals.

In an interesting chapter on the vegetation of the island, the authors describe the various plant formations and the ecological factors controlling them. Scrubby bushes are the climax vegetation of sheltered slopes and valleys, and the absence of trees is attributed, no doubt correctly, to wind action. Sheep constitute by far the most important biotic factor, and grazing has caused some species to disappear from all except the most inaccessible parts of the tussock grassland, while at least two species which are not touched by sheep have thrived exceedingly. We read that, in an effort to preserve the native flora, the New Zealand Government is planning to eliminate the sheep and cattle remaining on the island. Seals and birds have also modified the vegetation near their breeding areas on the beaches and cliffs. Unfortunately the authors give no check

list of the plants nor any indication of how many—if any—of the plants are specific or sub-specific to the island. Insect depredation of the plants is described as "comparatively light" and this seems to be the only reference to insect life in the book, except in the titles of certain of the Cape Expedition reports which show that a good deal of entomological work has been carried out.

There is much valuable information on the numbers, distribution, behavior, and food and breeding habits of the animals and birds on the island, with almost three-quarters of the book devoted to the birds. The numerous photographs of superlative quality are undoubtedly the outstanding feature of the book, while the collection of so much data from various sources under one cover provides an excellent reference. The marine mammals of the island comprise the Right Whale, New Sea Lion, New Zealand Fur Seal, Leopard Seal and Southern Elephant Seal. With New Zealand Government protective measures in force, the Right Whale, in season, is seen in large numbers around the coast, and the fur seal is on the increase again. On land, the accidentally introduced Norway Rat flourishes everywhere, and is very destructive to ground-nesting birds. The authors list sixty-one birds as recorded from the island, of which only twenty-six have been definitely noted breeding. The majority of the birds of the island are stragglers from Australia or New Zealand, and include such introduced European and Asian species as the Song Thrush, Blackbird, Hedge Sparrow, several species of finches and buntings, and the Starling. It is possible that the introduction with the sheep of certain pasture grasses may have assisted the finches to establish themselves. The authors quite properly devote most attention to the sea birds, including a hundred pages to the albatrosses, for which Campbell Island with six species, five of which are known to breed, is one of the finest islands in the world. By comparison a disportionately small space is devoted to the penguins, with six species, three of which are known to breed. The population of a single colony of Rockhopper Penguins was estimated at two and a half million birds. We find that only the Campbell Island Shag and possibly the Campbell Teal are endemic to the island.

The book would have been improved if the treatment of the various animal species was less discursive. The authors quote long sections of field notes, instead of extracting and synthesizing the essential data from them. The undigested field notes make tiresome reading, and some of the anecdotes which are included would have been more appropriate in a popular book than in the scientific publication of a museum. In short, we feel that the authors could have selected and organized their material better. Nevertheless, helped greatly by their exquisite photographs, they have succeeded in conveying to the reader a great deal of the special interest and fascination of a subantarctic island and its wild life.

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## Other New Titles

**Handbook of Snakes of the United States and Canada. Vol. III. Bibliography.** By A. H. and A. A. WRIGHT. (Privately Published) Ithaca, New York. 1962. 179 p. $3.00.

**Faunal Relationships of Birds in the Ilamna Lake Area, Alaska.** By FRANCIS S. L. WILLIAMSON and LEONARD J. PEYTON. Biological Papers of the University of Alaska No. 5. 1962. 73 p. $1.00.

**Characters of Age, Sex, and Sexual Maturity in Canada Geese.** By HAROLD C. HANSON. Natural History Survey Division, Urbana, Illinois. (Biological Notes No. 49) 1962. 15 pp. Free.

**The Grass Pickerel *Essox americanus vermiculatus* LeSueur in Canada.** By E. J. CROSSMAN. Royal Ontario Museum, University of Toronto. 1962. 29 pp. (Life Sciences Division Contribution 55).

**Sequence and Rate of Tooth Replacement in the Crocodilia.** By A. GORDON EDMUND. Royal Ontario Museum, University of Toronto. 1962. 42 pp. $1.50 (Life Sciences Division Contribution 56).

***Odocoileus salinae* and *Mazama* sp. from the Talara tar seeps, Peru.** By C. S. CHURCHER. Royal Ontario Museum, University of Toronto. 1962. 27 pp. $1.00 (Life Sciences Division Contribution 57).

# NOTES

## Flammulated Owl nesting in British Columbia

The Natural History Section of the Penticton Museum in the Okanagan Valley of British Columbia were particularly fortunate recently in obtaining an excellent specimen of one of the least known and perhaps rarest birds in Western North America—an adult female Flammulated Owl, *Otus flammeolus* (Kaup).

This piece of good fortune had its beginning June 12, 1962, when Mr. George Marshall of this city, a faller for local logging operators, felled a large old Ponderosa Pine which had a dead top. The tree broke up in falling and Marshall noticed a small bird fluttering about among the broken up mass of limbs, dead bark and splintered trunk. The bird turned out to be a small owl with a broken wing tip.

The bird was brought in to me the following evening, but we were unable to keep it alive as it refused to eat all offerings, including new born mice and the following day I had it gassed.

The beautifully marked little owl with its deep chocolate brown eyes, bare feet, and perceptible tufts (ears) offered no problem at identification, as it could not be confused with any other member of its family likely to be encountered here.

Mr. Abe Braun of Oliver, British Columbia, a well known taxidermist who mounted the specimen, reported the bird had recently laid her eggs and I therefore had Mr. Marshall conduct a further examination of the tree top. This resulted in finding the nesting hole, some egg shell and a considerable quantity of pellets which are being sent to the Provincial Museum at Victoria for study. We have also obtained a section of the tree trunk containing the nest hole.

The location of this find is about twenty miles west of Penticton on Shatford Creek and at an elevation of approximately 4,000 feet. The terrain is rough and broken and this is about the extreme elevation where Ponderosa Pine grows in quantity. Douglas Fir predominates and a few hundred feet higher this is replaced by Lodgepole Pine. The nest hole was between forty feet and fifty feet above the ground. The only sound we heard uttered was a sharp "click click" when the owl was disturbed.

Apparently there are only two other records of this species for British Columbia (Guiguet, 1960. British Columbia Provincial Museum Handbook No. 18)

—one at Penticton, November 1902, and the other at Lac du Bois, Kamloops district, in August 1935.

REG. N. ATKINSON

Curator
Penticton Museum & Archives
Penticton, British Columbia
16 August 1962

## A Surf Scoter Nesting Record for Northwestern Ontario

ON AUGUST 3, 1960, Michel Hunter of Winisk and myself observed an adult female and six one-third grown downy young Surf Scoters *Melanitta perspicillata*, on an unnamed lake at 55°15′N, 86°35′W. We collected the adult and one of the young and prepared them as study skins. They are now specimens *90959* and *90960* respectively in the bird collection of the Royal Ontario Museum.

Although adults are not uncommon during the summer along the Ontario shore of Hudson Bay, (Manning, T. H. 1952. Birds of the West James Bay and Southern Hudson Bay Coasts. National Museum of Canada Bulletin No. 125) this is the first record of the species nesting in Ontario.

The lake on which the brood was observed was about five square miles in area. It was a typical Hudson Bay Lowland lake being shallow and round and having the bottom covered with a thick layer of organic matter. The land surrounding the lake was rather typical of much of the area, being muskeg with the usual sparse stand of stunted black spruce.

Although I spent almost a month in similar habitat, in the area between Winisk and Shagamu Rivers, this was the only brood of Surf Scoters observed. Apparently this species is a very uncommon nesting bird in Ontario.

DONALD W. SIMKIN

Research Branch
Ontario Department of Lands and Forests
Maple, Ontario
1 April 1962

## Some Bird Observations on the Grand Banks of Newfoundland

FROM SEPTEMBER 13 to 21, 1961, the Fisheries Research Vessel, *A. T. Cameron*, carried out fish sampling operations on the Grand Banks of Newfoundland. The primary purpose of my trip, as guest of the Fisheries Research Board, was to collect and preserve marine invertebrates and fish specimens for the National Museum of Canada, and for that reason my time for collecting and observing birds was limited. However, through the kind co-operation of the scientific staff, captain, officers and crew of the *A. T. Cameron*, twenty bird specimens were collected (including nine Great Skuas) and observations made on ten species. Observations were made at various stations ranging from Lat. 46° 45′00″N. Long. 47°16′15″W. to Lat. 43° 30′00″N. Long. 48°40′30″W. The most easterly station was approximately 350 miles from St. John's, Newfoundland.

The Great Skua, *Catharacta skua skua* Brünnich, was the most interesting species observed, with as high as twenty individuals seen in a day. Contrary to some reports the Great Skuas were not found to be overly aggressive. On two occasions a member of the crew and myself watched a Fulmar chase a Great Skua away from fish refuse which had been thrown in the water. Captain Blackwood, in his many years of going to sea and having the opportunity of observing birds, does not consider the Skua an aggressive bird. He also mentioned that in recent years Skuas have increased in numbers.

Fulmar, *Fulmarus glacialis* (Linnaeus), was the most abundant species, with up to two hundred individuals being observed at one time. The four specimens collected are referable to the subspecies *minor*.

Greater Shearwater, *Puffinus gravis* (O'Reilly), is the next most abundant

species, with up to forty individuals counted at one time.

The Sooty Shearwater, *Puffinus griseus* (Gmelin), is not so plentiful as the Greater and does not come as close to the ship.

Wilson's Petrel, *Oceanites oceanicus oceanicus* (Kuhl), was observed each day. About twenty individuals were the most seen at any time.

The Leach's Petrel, *Oceanodroma leucorhoa leucorhoa* (Vieillot), was not seen very often. On several days none were observed.

Jaegers, *Stercorarius*, do not appear to be plentiful on the Banks at this time of year. Two Parasitic Jaegers, *S. parasiticus* were the most seen in one day. One Pomarine Jaeger, *S. pomarinus*, was collected.

Kittiwake, *Rissa tridactyla tridactyla* (Linnaeus), are uncommon on the Banks at this time of year – only two birds were seen. I did not observe any other species of Gulls on the Banks, although a member of the crew mentioned seeing two one morning.

Gannets, *Morus bassanus* (Linnaeus) were rarely observed, three birds being the most seen in one day, and on a number of days none were observed.

STANLEY W. GORHAM
National Museum of Canada
Ottawa, Ontario
7 March 1962

## An Unusual Leaf Inversion in Amabilis Fir

THE NEEDLES OF amabilis fir, *Abies amabilis* (Dougl.) Forbes, a common tree of the western slopes of the British Columbia coast range, are flat, about 1¼ inches long, deep blue-green and stoma-free on their upper surfaces, and silvery with two broad stoma-filled stripes on their lower surfaces. In May 1961 on Hollyburn ridge, near Vancouver, at an elevation of 3600 feet, an individual amabilis fir was found on which the needles of the 1961 growth region were the inverse of the needles of the 1960 growth region. The anomaly was such as to create an appearance along the shoots, of alternating silver and dark green regions. Furthermore, the anomaly must have been inherent, for evidences of the annual inversion were found in nearly all shoots, and over several growth increments along a shoot. The oldest regions of a branch possesed leaves which were normal or near normal; regions with intergrades and then regions with clear-cut alternation appeared as a branch tip was approached. Whether leaves terminal in 1961 were normal or inverted apparently depended on the region, green or silver, from which a shoot was derived. Anomalous leaves, with the silvery stomatal lines uppermost, were shorter than normal leaves and

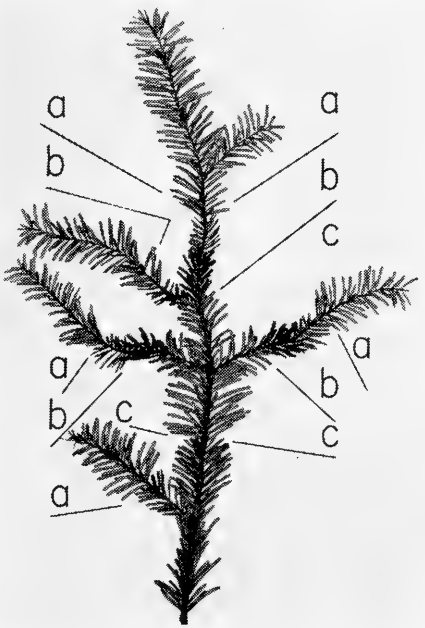


FIGURE 1. A shoot of amabilis fir showing (a) normal leaves derived from 1961 wood, (b) abnormal leaves derived from the 1960 wood, and (c) apparently normal leaves derived from 1959 wood.

tended to deepen in color as the season advanced.

A scrutiny of the plant teratological literature (Worsdell, W. C. 1915. *The principles of plant-teratology*. Dulau and Co. Ltd.) and requests directed at foresters did not elicit a record of similar anomalies. In view of the fact that stomatal placement is used taxonomically to some extent, and, in view of the interest in plant hormones and competence in meristematic regions, the record of this anomaly seems to be worthwhile.

V. C. BRINK
K. BILLER

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Vancouver, B.C.
19 October 1961

## A Range Extension of the Dusky Salamander in Quebec

THE DUSKY SALAMANDER, *Desmognathus fuscus fuscus* (Rafinesque), was added to the Quebec herpetofauna in 1950 (Mélaçon. 1950. Inconnu et Meconnu. La Société Zoologique de Québec). Recently, while examining the collection in the Redpath Museum, McGill University, a Dusky Salamander specimen was discovered identified as "*Desmognathus nigra*" from "St. Andrew, Quebec". The specimen, which has a bifid tail, had been prepared for display and was labeled in the handwriting of Mr. Edward Ardley. Mr. Ardley was a technician in the museum during the tenure of Sir William Dawson, who was principal and vice-chancellor of McGill University from 1855 to 1893. This specimen has been unnoticed by herpetologists although it has apparently lain in public view for about a century. It was most likely collected by Sir William Dawson himself.

St. Andrew (now St. André Station or the town of St. André four miles to the northwest) is in Kamouraska County, Province of Quebec, at approximately 69°40'W., 47°38'N. It lies 41 miles to the northeast of Lac Trois Saumon, the farthest point north at which this species has been collected previously (Bleakney, 1958. A zoogeographical study of the amphibians and reptiles of eastern Canada. National Museum of Canada Bulletin 155).

An interesting aspect of this find is that searching farther to the northeast by Trapido and Clausen (1938. Copeia: 117), Bleakney (*op. cit.*), and the author has failed to find this species in seemingly suitable habitats. Whatever factor (or factors) limits its range, the Dusky Salamander in this part of Quebec must reach the limit of tolerance for the species within a few miles of St. André.

I wish to thank Dr. Austin Cameron, Curator of Zoology, Redpath Museum, McGill University, for the opportunity to examine and report on the collection.

NORRIS S. DENMAN

350 William Birks St.
St. Bruno, Quebec
5 December 1961

## Sight Record of the Tufted Duck at Vancouver, B.C.

ON NOVEMBER 4, 1961, Mr. Edwin Moodie phoned me that he and Mr. John Toochin had seen a Tufted Duck, *Aythya fuligula*, on Lost Lagoon, Stanley Park in Vancouver. Dr. Ian Mct. Cowan, of the Department of Zoology, University of British Columbia, saw it on that date and confirmed the identification and also that it was an immature male.

On November 5 I met Mr. Moodie and he told me it was on the salt water off Second Beach, Stanley Park, among a flock of Surf Scooters, *Melanitta perspicillata*. As we approached Second Beach this duck and the Surf Scooters were disturbed by a passing motor boat and they all took flight. After several hours scanning large concentrations of

mixed flocks of scooters, scaup and other water birds off shore from Second and Third Beaches, we went back to Lost Lagoon and found it, where I had an excellent view of it through a 20 x 60 telescope. While on Lost Lagoon it associated with Greater Scaup (*Aythya marila*), Common Goldeneye (*Bucephala clangula*) and Barrows Goldeneye (*Bucephala islandica*). The last date it was seen was November 11. Many people had the opportunity of seeing it. To mention a few—Mr. and Mrs. Werner Hesse, Mr. R. F. Oldaker, Mr. Norman Precious, Miss Doris Nye.

The A.O.U. Check-list of North American Birds (1957, 5th Ed., p. 84) includes records from Greenland; Newbury port and Marshfield, Massachusetts; and St. Paul Island and Attu Island, Alaska. Recent records (Oson 1961, The Auk 78: 638-639) are from Portland, Oregon and (Arr, 1962, The Auk 79: 482-483) from California. As far as I can ascertain this is the first Canadian record of this species.

WILLIAM M. HUGHES
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14 October 1962

## Insects reared from the Red Pouch Gall of Sumac and the Rough Bullet Gall of Oak at London, Ontario

ON SEPTEMBER 28, 1960 twenty-five galls were collected from leaves of Staghorn Sumac, *Rhus typhina*, in an abandoned brickyard bounded by Cheapside, Taylor, Victoria and Adelaide Streets in London, Ontario. The galls were pear-shaped swellings on the lower surface of the leaf, hanging from the mid-rib of the leaflets about one-quarter of an inch from the main mid-rib of the leaf. There was one gall on each leaflet. The galls were from one-half to one and a half inches long. The shorter galls were covered with a heavy coat of furry hairs like those on the leaflets while on the larger galls the coat of hairs was more sparse. The galls were yellow-green flushed with red. They were identified as Red Pouch Galls caused by the aphid, *Melaphis rhois* (Fitch) by using keys and descriptions in E.P. Felt (1940, Plant galls and gall makers, Comstock Publishing Company, Ithaca).

When the galls were being collected a few winged aphids crawled from them. The emergence hole in a gall was a short split in the base of the gall near its attachment to the leaflet. When the galls were dissected they were found to contain a powdery mass of white shed nymphal skins with yellow wingless aphids crawling among them. More winged adults were found as well. Altogether, fifty winged adults and forty wingless forms were collected. They were identified as *Melaphis rhois* (Fitch) by Dr. W. R. Richards, Entomology Research Institute, Department of Agriculture, Ottawa. The Red Pouch Gall has been reported in the United States by F. C. Hottes and T. H. Frison (1931, Bulletin, Illinois Natural History Survey 19: art. 3) and in Canada by J. C. Burnham (1938, Canadian Entomologist, 70: 180-188). The collection made by Burnham was on October 14, 1936, a few weeks later than the date of collection of the galls in London. A. C. Baker (1919, Entomological News 30: 194-196) described *Melaphis minutus* collected on moss in Virginia on May 5, 1916 and suggested the possibility that it was the spring form of *M. rhois*.

On October 23, 1960 twenty galls were collected from twigs on two saplings of Bur Oak, *Quercus macrocarpa*, on the south bank of the South Branch of the Thames River one-quarter mile east of Meadowlily Road. The structure of the galls was as described by W. W. Judd (1957, Entomological News 68: 193-195). They were identified with Felt's key (op. cit). as the Rough Bullet Gall caused by the cynipid wasp *Disholcaspis mamma* (Cresson). Two of the

galls each had an emergence hole 2 mm. wide while the other eighteen were intact and were placed in vials for rearing. Two of the galls yielded one female each of *D. mamma* on October 24. They were identified by Mr. L. H. Weld, United States National Museum, Washington. Five other galls yielded small wasps in January, 1961 as follows: Jan. 10—6 ♂♂, 19 ♀♀; Jan. 11—2 ♂♂, 16 ♀♀; Jan. 15—4 ♂♂, 9 ♀♀; Jan. 17—9 ♂♂, 36 ♀♀; Jan. 18—5 ♂♂, 31 ♀♀ (i.e. 81% ♀♀). They were identified by Mr. B. D. Burks, United States National Museum, as *Tetrastichus racemariae* Ashm. (family Eulophidae). Mr. Burks, in the letter of identification, pointed out that he considers *T. phegus* to be a synonym of *T. racemariae*. *T. phegus* was reared from galls of *D. mamma* at London by Judd (op. cit.) in 1956.

All specimens reared from the sumac galls and oak galls are deposited in the collection of the Department of Zoology, University of Western Ontario.

WILLIAM W. JUDD

Department of Zoology
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London, Ontario
13 September 1962

## Notes on the Distribution and Reproduction of the Fish *Tautoga onitis* in Nova Scotia

THE TAUTOG, *Tautoga onitis* (Linnaeus), is an inshore fish of rocky shoals where it feeds chiefly on mussels, snails and crabs. Its center of abundance lies to the south of Cape Cod. North of that area it is much less common and more local and is a rarity in New Brunswick and Nova Scotia (Bigelow and Schroeder, 1953, United States Fish and Wildlife Service, Fisheries Bulletin No. 74). However, because our coastal waters were considerably warmer a few thousand years ago, there always exists the possibility of relict disjunct populations of this species in a few of the more protected bays of Nova Scotia where summer temperatures warm to the level required for the incubation of the floating eggs. One such area was reported by Leim and Day (1959, Journal of the Fisheries Research Board of Canada 16(4): 512) at Eel Brook Lake, a saltwater lake in Yarmouth County. A sports fishery first developed there in 1957 and over two thousand fish were caught.

Prior to this Eel Brook Lake report, only three specimens were known from Nova Scotia, one each from Scotts Bay, Kings County, 1902; Petpeswick Harbour, Halifax County, 1903; and Cranberry Head, "Yarmouth County", 1912 (Vladykov and McKenzie, 1935, Proceedings of the Nova Scotia Institute of Science 19(1): 100). The 1912 record was originally published by H. W. Fowler (1915, Proceedings of the Philadelphia Academy of Science 67: 517) simply as "Cranberry Head" with no reference to any county. In all the subsequent literature it mistakenly appears as "Cranberry Head, Yarmouth County." The only Cranberry *Head* in Nova Scotia is on the Bay of Fundy shore of Cumberland County, 130 miles northeast from Cranberry *Point*, Yarmouth County, the name which probably contributed to the confusion of the locality.

It is not known whether these records indicate a self-sustaining population of tautogs in each locality or simply stray individuals from farther south. The latter would account for the Scotts Bay and Cranberry Head reports from the cold waters of the Bay of Fundy. The Petpeswick Inlet area, however, is seven miles long and only one quarter to one mile wide with a very narrow constriction about half way up the inlet and offers a real possibility of being the site of a relict population.

A fifth locality record was established for the species on July 2, 1962, when the author speared an 18¾ inch, six pound female tautog off Crane Point on Marvin Island at Chester Basin in Mahone

Bay, Lunenburg County. The author, accompanied by Mr. A. Redden and Mr. H. Foote, was scuba diving along a rocky shoal rich with mussel beds when the fish was sighted resting against the base of a rock in five feet of water. The same fish, or a similar one, was seen swimming over the same shoal on June 2, 1962. Broken shells of the horse mussel, *Volsella modiolus*, and common periwinkle, *Littorina littorea*, were in its stomach. The body cavity was distended by the greatly enlarged ovaries which contained eggs of different sizes including a great many fully mature ones 1.0 mm in diameter. On September 9, 1962, while snorkeling over the same shoal, Mr. H. Foote observed two more tautogs, a large dark one and a pale smaller one. This indicates the possibility of local spawning activity of a relict population of *Tautoga onitis* in the warmer inner reaches of Mahone Bay.

J. SHERMAN BLEAKNEY
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Halifax, Nova Scotia
23 October 1962

## Unusual Nest Site of the Glaucous-Winged Gull

ON JUNE 15, 1962, while scanning Vancouver Harbour with my telescope, I saw a Glaucous-winged Gull, *Larus glaucescens*, sitting on a nest on the north end of the main roof of the Canadian National Steamships Dock, in the heart of the city's waterfront This gravelled roof, 100 feet above mean high tide, is approximately 120 feet long by 100 feet wide, and is almost flat, sloping to east and west only enough to permit drainage. The east and west sides are unenclosed, but the north wall of the building extends about five feet above it. The nest was built in the shelter of this wall, on the peak of the roof.

My fifth-floor hotel room, from which I can see most of the roof, is southeast of the dock and .49 mile (computed from Vancouver Harbour Chart No. 3418) from the nest site. Using the telescope at 40x, I watched the nesting birds daily, and was delighted to find that one of them was a personal friend who has come regularly to my window-ledge for food since November, 1959. This bird, judged by his aggressiveness, large size, flattened profile, and massive bill, is probably the male. He dominates all the gulls in this area and is known to us hotel residents as "the boss-bird".

Incubation duty was shared in daylight hours, but the boss-bird invariably took the night shift alone, his mate flying about two miles, just before dark, to roost on the log booms on the north shore of Burrard Inlet. This routine was followed until the chicks were full-grown.

A chick was hatched on July 10, and another on July 11. The parents continued to incubate, without result, until July 14, but the nest was used for brooding and shading the chicks until July 16, when it was abandoned. (Mr. Wm. M. Hughes' examination of the nest on July 31 revealed that a third chick had died in the shell.) The family then moved into the shade of the facade and neon sign at the south end of the roof, where they remained hidden through the hot days, venturing out only in the evenings to stroll on the roof; and, as they grew older, to exercise their wings. It was there, crouched among the steel supports of the sign, that Mr Hughes found them on July 31, when he applied their Wildlife Service bands. The chicks roosted in this hiding-place until they were nearly full-grown, while the boss-bird slept on a pillar directly above them, apparently unmindful of the glare of the sign.

The chicks were seen exercising their wings when only twenty-four days old. At thirty-seven days they could lift themselves about two feet into the air, but it was not until August 28, at forty-nine days, that I saw them actually airborne and flying short distances above

the roof. On August 31 they were making extensive flights over the immediate dock area. I did not see them roosting on the roof after September 19, but they were fed there, together or singly, until October 10.

The boss-bird's foraging visits increeased proportionately to the demands of the growing chicks until, when they were ready to leave the roof, he was making from five to eight trips every evening, the last often being made after dark. His latest visit was at 9:40 PM (DST) on September 16, two hours and twenty minutes after sunset. I took advantage of this daily "airlift" to clock his flights from window-ledge to dock roof. On still evenings the time ranged from fifty-eight to sixty-one seconds, according to slight variations in his route. The mean of twenty trips was sixty seconds. The distance being .49 mile, his speed averaged 29½ mph. Once, with a light southeast wind on his tail, he made it in fifty-five seconds, at a speed of 32 mph.

On September 21 one of the siblings followed the boss-bird on his visit to my ledge, alighting on an adjoining roof. I read its band number with my telescope and reported the sighting to the Bird Banding Office. On October 10 it was bold enough to come to the ledge with the parent. It was given a royal welcome, and is now a regular visitor.

Isolates of this colonial species are not uncommon (*see* Drent and Guiguet, Occasional Papers of the British Columbia Provincial Museum, No. 12) but this is, I believe, the first record of a successful nesting on the roof of a city building.

I am grateful to Mr. J. Gillan, of the Canadian National Steamship Company, for his co-operation in obtaining permission for Mr. Hughes to climb to the roof, and in ensuring that the gulls were allowed to nest undisturbed.

FRANK OLDAKER

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23 October 1962

## Baltimore Oriole Recorded for Cape Breton Island

ON JUNE 11, 1962, a male Baltimore Oriole, *Icterus galbula*, was observed on five different occasions at Little Judique, Inverness County, Cape Breton Island. This appears to constitute the first record of this species for the island.

The area in which the bird was seen is typical habitat for the species. A small, shrub-bordered stream flows through extensive meadowland with elms growing along the stream edge and in scattered groups throughout the meadow. The oriole was seen in both the shrubbery and in the elms and was observed at close range and in good light on all occasions. Since it was a male in full nuptial plumage, there is no possibility of misidentification.

This bird is uncommon in peninsular Nova Scotia and on Prince Edward Island. Among the few records are those of nests at Berwick (1938, Canadian Field-Naturalist 52: 109) and Gaspereau (1959, Nova Scotia Museum of Science Newsletter 2 (4): 79) in the Annapolis Valley of Nova Scotia as reported by Tufts. Godfrey (1954, National Museum of Canada Bulletin 132: 204) lists one specimen record from York (near Charlottetown) and three sight records for Prince Edward Island. The scarcity of records for such a conspicuous species is highly indicative of an actual low population density in the Maritime Provinces, which is surprising since the elm is widespread throughout the region.

AUSTIN W. CAMERON

Redpath Museum
McGill University
Montreal 2, Quebec
1 November 1962

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## Articles



## Reviews



## Notes



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# NOTES ON THE DISTRIBUTION AND LIFE HISTORIES OF TURTLES IN NOVA SCOTIA

J. Sherman Bleakney
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The central region of the south projecting peninsula of Nova Scotia is the richest area for individuals and species of reptiles in Canada east of southern Ontario. From this climatic pocket, relict populations of the Ribbon Snake, *Thamnophis sauritus* (Bleakney, 1951), and Blanding's Turtle, *Emydoidea blandingi* (Bleakney, 1958 p. 25, 39), have been reported. Recently more information has been gathered on the biology of turtles in Nova Scotia and this paper summarizes some of the data and points out the problems which have come to light.

## Distribution

All the species of reptiles recorded from Nova Scotia are common and even abundant in the south central area, with the one exception of the Wood Turtle, *Clemmys insculpta*. It has never been reported south of Annapolis County or Halifax County but is widely distributed to the north throughout mainland Nova Scotia and essentially all of New Brunswick. At first, it seemed that habitat preference explained its absence from the lakes and bogs in the granite and slate formation of southern Nova Scotia for it is most commonly seen along slow streams and rivers in fertile valleys. However, it has recently been found in southwestern Halifax County, which is the same rock formation as the rest of the southeastern slope of Nova Scotia. Babcock (1919) also noted its abundance in some areas of New England and its scarcity or absence in others. Competition with other turtles may be a contributing factor, for *Clemmys* is more common to the north where *Chrysemys picta* and *Chelydra serpentina* are less common or absent. In certain valleys, however, such as the Annapolis Valley and the Musquodoboit Valley, *Clemmys* inhabits the streams in company with *Chrysemys* and *Chelydra*. In both Nova Scotia and New Brunswick, *Clemmys* prefers stream and river banks where it escapes by plunging into the water and swimming into the depths. It is not known if the young of this species overwinters in the nest in Nova Scotia as no nests or hatchlings have ever been observed.

The 1958 report of *Emydoidea blandingi* was based on one captured specimen and two sight records; all adult females observed on land during the June egg laying season. Additional data gathered since then has been summarized in Table 1. Each field party had its headquarters adjacent to the Federal Fish Culture Station, New Grafton, Queens County. The Station is only 500 feet from the east shore of Lake Kedgemakooge (also known as

Mailing date of this number: August 9, 1963.

Lake Kejimkujik and Lake Kedge) precisely where the first *Emydoidea* was captured in 1953. The perplexing aspect of the quest for specimens from this relict population of *Emydoidea* centers around the fact that the species was seen only when the females sojourned on land in search of nesting sites. Many hours were spent with binoculars searching Lake Kedge, Grafton Lake, and Snake Lake, the area adjacent to the known nesting sites, with negative results. *Chrysemys* and *Chelydra* were seen in abundance on these occasions. In southern Ontario, where the author used the same survey techniques, the same three species of turtle were located without any difficulty.

During June, 1961, three females were taken, again at the Fish Culture Station, but day and night hunting, bait trapping and swimming with mask and snorkel in the adjacent bodies of water yielded no additional specimens. After eight more days of negative results, the frustrated crew gave up, and went fishing in the West River, a meandering stream five miles away on the western shore of Lake Kedge. Here they discovered basking adult male, female and juvenile *Emydoidea*, as well as the ubiquitous *Chrysemys* and *Chelydra*. A visit to the West River on August 2, 1961, resulted in the capture by hand of a basking *Emydoidea*. This basking behaviour, seemingly confined to the West River, is not due to remoteness from man because this is a favorite fishing and hunting stream. It is difficult to imagine that the West River *Emydoidea* swim five miles of lake to nest with *Chrysemys* and *Chelydra* near the Fish Culture Station when there are suitable egg laying sites in the immediate area. Note that in 1961 two men during June, July, and August spent 17 days on the east side of Lake Kedge and saw no basking *Emydoidea*, but found three nestseeking females. In contrast, two men made only four visits in July and August to the West River and captured basking *Emydoidea* each time. This author is at a loss to explain the apparent basking and non-basking behaviour of respective *Emydoidea* populations on the east and west sides of Lake Kedge; that is, if there is an east-side population!

## NESTING

An unusual opportunity arose in 1959 to study the incubation of *Emydoidea* and *Chrysemys* under identical conditions at Lake Kedge. A female *Emydoidea* was captured in the act of digging a nest at the Fish Culture Station. The area had been bulldozed for purposes of damming the stream from Grafton Lake and terracing a slope for a residence. Back of this house is a flat yard and a slope of exposed gravel and sand. It is a favorite site for turtles to lay during late June and early July. In the early evening of June 30, 1959, Mr. Ronald Hawkins, Officer-in-charge, noticed the *Emydoidea* digging and immediately put the turtle in his basement. At 2130 hours, July 1, she was returned to the incompleted nest hole and covered with a box weighted with stones to keep out raccoons. At 2330 hours she was digging rhymically, apparently undisturbed by the unfamiliar dark confines of the box. When checked again at 0900 hours on July 2, she was thrusting against the box to escape. The turtle (carapace length 217 mm) was kept on display at the Nova Scotia Museum of Science and not preserved until November, 1960. The nest was located and dug into to verify the egg laying and the

TABLE 1. Summary of information on *Emydoidea blandingi* from Lake Kedgemakooge, Nova Scotia.

| Field Party Dates | Observations and fate of specimens |
|---|---|
| 1950 (author)<br>1-20 July | — No reason to suspect its occurrence in Nova Scotia. Not looked for, not seen. |
| 1952 | — Vacationers capture female on beach 3300 feet southwest of stream mouth at Fish Culture Station. Carved "1952" on plastron. Released. |
| 1953 (author)<br>7-14 June | — June 8, caught same turtle as above on lake shore at mouth of stream at Fish Culture Station. Preserved. |
| 1955 (author)<br>4-22 July | — Two adults caught on F.C.S. grounds by Officer-In-Charge the week previous to July 4 and released in adjacent Grafton Lake. |
| 1958 | — Report of live adult on display at Annual N. S. Guides Meet. Released. |
| 1959 (author)<br>23 June-4 July | — June 30, female found digging nest. Female, one egg and five hatchlings preserved. |
| 1959 | — Mid-July report of adult found on road, escaped into L. Kedge same day. |
| 1961 (author)<br>19-23 June | — June 19, two females found in concrete sluiceway of Grafton Lake dam at Fish Culture Station.<br>— June 20, female found digging on beach at mouth of stream at F. C. S. |
| 1961<br>3-15 July | — July 11, 12, 13, two adult females, one adult male, one juvenile female, and one juvenile male found basking on rocks and logs up the West River, five miles west of F. C. S. |
| 1961<br>1-3 August | — August 2, basking adult female caught by hand in West River. All 1961 specimens had shells dried and viscera preserved. |
| 1962 | — May 28, fishing party caught adult in dip net up the Little River, five miles westnorthwest of Fish Culture Station. Escaped from car near Wolfville, N.S. |

uppermost egg removed and preserved. The nest area was covered by a square yard of heavy metal screening and the edges were rocked down to prevent predation by raccoons. The nest site was a south exposure and wind protected on all sides by trees and the house except for a southeast opening to Grafton Lake, which was only one hundred feet away.

The basic characteristic of the microclimate of chelonian nests is day heating and night cooling as is evident in the morning and afternoon temperature profiles of Figure 1, and in the graph of soil temperature profiles in Brooks (1960: 79). Any factor which affects heat transfer to and from the soil will profoundly effect the length of incubation. Breckenridge (1960) feels that screening over a nest shades it and thus lessens the total heat normally received by that microhabitat area. He measured the soil temperature at the five inch depth on two occasions in July and found the temperature to be

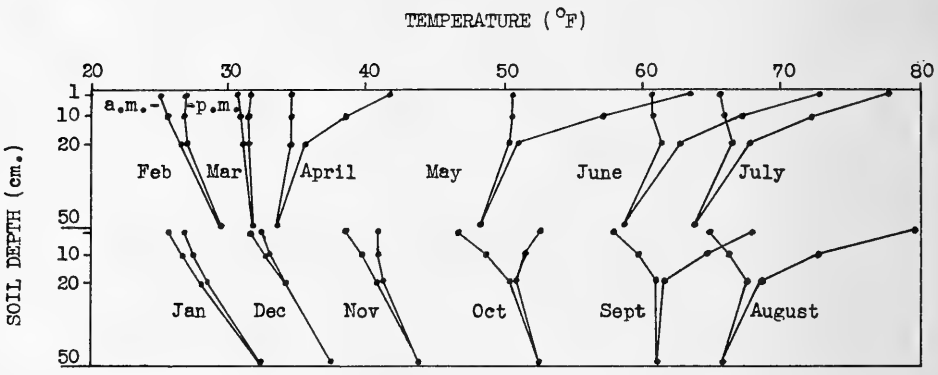


FIGURE 1. Early morning (0800 hrs) and late afternoon (1700 hrs) soil temperature profiles at Fredericton, New Brunswick, based on monthly means from 1959 to 1962. Turtle nests would be subjected to the environmental conditions of the 10 cm level.

0.5°F and 1.5°F lower under the screening. There is, however, the possibility of the "greenhouse effect" here, where heat loss at night is lessened by the presence of the screen cover. A constant temperature recording apparatus might even show that although less heat was gained during the day under the screen, there was less heat lost at night, so that the total energy gain may be the same over a twenty-four period or the "greenhouse effect" might actually raise the mean temperature of the soil above normal and thus hasten incubation. The screening and the circle of rocks at the *Emydoidea* nest would have considerable effect as wind shield and thus lessen evaporation and cooling. In addition, the angular surfaces of the rocks could reflect additional heat onto the ground and into the air above the nest.

## HATCHLINGS

A *Chrysemys* was observed on the night of July 3, 1959, laying eggs only eight feet from the screened over *Emydoidea* nest and next morning the area was covered with screening. Both nests were kept under observation and on September 27 the *Emydoidea* hatchlings emerged, after a period of 88 days. This is the first time an incubation period has been reported for this species. Hatchlings have previously been found in September by Conant (1938) and Sexton (1957). The *Chrysemys* hatchlings first appeared on April 7, 1960, when three dug out to the surface after a period of 277 days. There had been snow over the nest the previous week, the adjacent Grafton Lake was ice-free only at the margins and this was freezing over each night, and wood frogs, *Rana sylvatica*, and spring peepers, *Hyla crucifer*, were not due to start calling for at least another ten days. The three hatchlings partially reburied themselves as the day cooled. The nest was dug out and seven hatchlings found which ranged in carapace length from 25 to 26 mm. Five were immediately preserved and two committed to an aquarium. Of the five preserved ones, only one has the caruncle. This would indicate that the actual incubation period was probably from June to late September or October

TABLE 2. — Measurements (in millimeters) of hatchling *Emydoidea blandingi* from Nova Scotia

| Specimen No. | Carapace | | Plastron | |
|---|---|---|---|---|
| | Length | Width | Length | Width |
| 1 | 31.25 | 27.0 | 27.0 | 16.5 |
| 2 | 32.0 | 29.0 | 28.5 | 17.0 |
| 3 | 32.0 | 29.0 | 28.0 | 17.0 |
| 4 | 32.0 | 28.0 | 27.5 | 16.25 |
| 5 | 30.5 | 27.0 | 27.0 | 16.25 |
| 6 | 32.0 | 29.0 | 28.5 | 17.0 |
| 7 | 31.0 | 29.0 | 27.5 | 17.0 |
| 8 | 32.0 | 29.5 | 28.0 | 17.0 |
| 9 | 31.5 | 29.0 | 27.5 | 17.0 |

since for many species of turtles the caruncle is not shed until ten days to four weeks after hatching (Oliver, 1955: 256). Sexton (1957: 230) described a clutch of *Chelydra* hatchlings where shedding of the caruncle varied from four to seventeen days. The *Emydoidea* hatchlings were first seen by Mr. Hawkins on September 27, 1959, when he counted six at 1200 hours and again at 1500 hours. On September 28, nine hatchlings were under the screen and in the nest cavity was an unhatched egg which contained much yolk and a small leathery embryonic disc. As one egg had been preserved on July 2, this brought the clutch to eleven. The nine hatchlings were measured at the nest (Table 2) and then because of the local rarity of the species a hopeful measure of conservation was practiced by releasing four into Grafton Lake. They were buoyant and paddled along the surface away from the dam and into a bed of water lilies. A half-grown Bullfrog, *Rana catesbeiana*, jumped and snapped at one little turtle but missed, whereupon the hatchling lowered its head, released bubbles of air and sank vertically to the bottom ooze and crawled out of sight. Of the remaining five specimens, two were preserved and three maintained in an aquarium until they died on December 29, 1959; March 12, 1960; and May, 1960 respectively. Not until October 13 did these hatchlings show any interest in food. Two of them ate earthworms and whiteworms on this date but the third, still possessing its caruncle, refused to feed. On October 19, its caruncle was gone and it ate readily with the others. During the rest of their winter captivity, various food items were offered the turtles. They fed mostly on worms and beef liver and refused house flies and crushed snails. The same food item was often accepted one day and refused on another. They were always slow and deliberate in their feeding actions and if a piece of liver proved too large, they shredded it with the claws of the forefeet as would an adult turtle. The most interesting behaviour observed was on October 29 when guppy fish were first introduced. A dead guppy finally excited one hatchling to a state where it bit off the fish's head but then spat it out and showed no further interest. Three live guppies were then put into the tank and the immediate reaction was dramatic.

The usual plodding pace of the hatchlings changed to an all out frantic swimming pursuit accompanied by shooting out their necks and snapping when at close range. The live fish were left in the tank overnight but were still swimming free the next day and were removed. On December 6, three guppies were again put in with the turtles and the same pursuit took place. One turtle managed to grab a fish and succeeded in swallowing it whole. The other two fish continued to evade the hatchlings so they were killed and waved in front of the two turtles who immediately seized and swallowed them. The reaction of these hatchlings to actively swimming prey is probably satisfied under natural conditions by the pursuit of aquatic insects which would be more easily caught than fish. Lagler (1943) found that the adult *Emydoidea* in Michigan fed primarily on crustaceans and insects. The major food items found in eight Nova Scotia specimens were dragonfly nymphs, aquatic beetles and snails, with fish remains in but two specimens and one of these was obviously carrion. (The absence of crayfish in Nova Scotia is strikingly evident in stomach analysis reports of our local turtles, Bullfrogs and raccoons).

Two of the *Emydoidea* hatchlings have anomalous central laminae (epidermal scales) on the carapace. On specimen No. 6 of Table 2, central lamina number 2 is continuous with central 3 on the left side, and centrals 4 and 5 are both doubled by diagonal sutures. Turtle No. 7, Table 2, has an extra wedge-shaped central lamina on the right side between centrals 4 and 5.

The illustrations of *Emydoidea* hatchlings in Agassiz (1857, Part III, Plate IV, No. 20) and Conant (1957, p. 24; and 1958, Plate 6) do not depict the spots on the marginal, lateral and central laminae which are distinctly evident in the Nova Scotia specimens. Each lateral lamina has a central pale spot (0.5 to 1.5 mm diameter) usually rounded with an irregular margin, although some are elongate. On the largest hatchling they are as conspicuous as those on the spotted turtle, *Clemmys guttata*, hatchling of Conant's 1958 Plate 6. In addition, three of the five specimens have a pale spot near the posterior margin of the first central. On the marginal laminae of the right side, four specimens have a spot near the medial boarder of numbers 4, 5, and 6, and the other specimen only on 5 and 6. On the left marginals, each animal differs slightly with spots on 5; 4 and 5; 4, 5 and 6; 3, 4, 5 and 6; and 4, 5, 6 and 7. Whether this spotting has any geographic significance cannot be determined until more hatchlings are examined. Smith (1961) says the carapace of hatchlings in Illinois "is uniformly black or is black except for a poorly defined light spot within each carapace shield." The spotting may simply have been overlooked in older descriptions, although Agassiz (1857, p. 442) states very definitely that the young are "entirely black above, without a spot." In all other respects, the Nova Scotia hatchlings agree with the color plate of Conant, 1958.

## Developmental Rates

Even when one assumes these April 7 *Chrysemys* eggs actually hatched in October or November, it is apparent that the *Emydoidea* eggs are cold adapted, for under identical conditions they finished development first. When

the greater mass of the *Emydoidea* egg and the slightly greater depth they were buried in the soil are both taken into account, one must conclude the embryonic developmental rate of *Emydoidea* is appreciably faster. The range of the species is certainly centered along the northern limit for turtles, and it has been observed swimming under ice and noted emerging from hibernation in Ohio in January (Carr, 1952). The fact that the eggs of *Emydoidea* are adapted for fast development at cool temperature and that the adult can be active under ice further indicates that some factor other than temperature is responsible for the species status in Nova Scotia and New England where its rarity and disjunct distribution indicate a relict species poorly adapted to this area. In fact, *Emydoidea* is so poorly adapted that the southern genera *Chrysemys* and *Chelydra* are far more common and even range considerably farther north. These wider ranging species are probably recent invaders of the northern latitudes as indicated by their emerging from the nest after periods of ten to twelve months.

## OVERWINTERING

In Nova Scotia, no hatchling *Chrysemys* or *Chelydra* have yet been observed in the autumn. What few observations there are were made at the Lake Kedge Fish Culture Station where turtle laying is concentrated and where observant adults and children are on the property daily. On July 1, 1954, the Officer-In-Charge, Mr. C. Baxter, was randomly searching for a turtle's nest in the gravel of his back yard and instead turned up a hatchling *Chelydra*. A hatchling *Chrysemys*, coated with earth, was found struggling across the lawn on June 24, 1959, and another on July 4, 1959. Remains of *Chrysemys* hatchlings, apparently picked to pieces by birds, were found at a nest hole on top of the Grafton Lake dam on June 18, 1961. One additional hatchling, with 0.25 mm of new growth evident on its shell was collected in Methall's Lake, Kings County, August 2, 1961, and presumably had emerged some time in July. This spread of the dates of emergence from April 7 to July 4 may simply be the result of late laying and the microclimate of individual nests.

The present author feels that references to overwintering of turtle hatchlings in the nest tend to be superficial because the basic problems involved have not been clearly stated. It is hoped that the following remarks will stimulate more interest in this topic. As adult turtles, and reptiles in general, are believed to hibernate below or at least near the frost line, there seems to be some reluctance to state that turtle hatchlings in a nest are subjected to subfreezing temperatures for long periods of time. Reference to studies on adults of various poikilotherms is of interest. Bailey (1949) found that hibernating snakes in Iowa could not tolerate lower temperatures than about -2°C (28°F) for long periods; this was at a soil depth of eighteen inches where frost penetrated to twenty-four inches. Neill (1948: 114) found that a sudden cold snap in late autumn made box turtles too torpid to burrow and they froze. Under normal circumstances they would burrow into the ground in autumn and deepen the burrow during the winter keeping below the lethal

temperatures. Bohnsack (1951, 1952) found that frogs hibernating on land in shallow pockets of forest duff, which has high insulation qualities, are rarely exposed to freezing temperatures. Bailey (1949) makes the point that hatchling turtles overwintering at depths of only three inches are likely to be hibernating above the frost line. There is no doubt of this in Nova Scotia, where a habitat of sand and gravel can have a frost penetration of three or more feet and the lakes can form ice to a depth of over thirty inches. If one assumes that hatchling turtles because of their small size are physically incapable of digging down as the soil temperature lowers, then in a winter of little snow cover, there is no doubt that hatchlings at depths of two to six inches are subjected to temperatures much lower than the minimum generally attributed to adult turtles. The minimum soil temperature recorded at Fredericton, New Brunswick, in February was 1.7°F at 10 cm and 6.8°F at 20 cm. Perhaps the amount of yolk content in their blood and tissues accounts for a lower lethal temperature level than adults of the same species.

There is some evidence (Woolverton, 1961; Hartweg, 1944) that in many nests the hatchlings are out of the shells in the autumn and thus apparently capable of emerging, but for some reason wait until spring to dig out. Hartweg (1944) suggested hard packed autumn soils trapped the young and spring rains were necessary to soften the ground so that the hatchlings could dig out. Sexton (1957) disagreed and pointed out the typical meteorological pattern of spring and autumn rains which certainly soften the soils at both seasons. He went on to suggest that overwintering in the nest is a behavioral adaptation enabling *Chrysemys* to survive in northern regions. But why a behavioral preference for a three inch cover of sand and gravel when a cover of organic rich soil or water would offer far better thermal protection? A better adaptation for survival of hatchlings in northern latitudes should consist of something which frees them from a winter just below the soil surface, such as smaller eggs or a faster rate of embryonic development or a combination of both, or even hyperdevelopment of the forelimbs (as in the opossum) for digging down deeper to keep ahead of the frost penetration. Any hatchlings which emerge in the early days of spring, minus the caruncle, as did the Nova Scotia *Chrysemys* of April 7, must have been equally prepared and capable physically of emerging when hibernation began. Sexton (1957) made the significant observation that the nesting season in 1955, about two weeks in advance of other years, did not effect the average dates of spring emergence and he concluded that *Chrysemys* regularly overwinter whether the nesting season is early or late.

Until we know precisely what stimulus (or stimuli) excites the hatchlings to dig out, we cannot answer the question of what inhibits this stimulus in the autumn and releases it in the spring. Carr (1960, p. 22) has shown that simple negative geotropism is not the answer with sea turtle hatchlings. When the eggs have hatched, the total weight of hatchlings upon the bottom individuals stimulates them to struggle out from under and this precipitates a wave of agitation through the mass to the diggers at the top. The same emergent process may apply to other turtles, but whatever it is, there is some

inhibiting factor in the nest in autumn which changes in early spring. Temperature would seem to be the logical variable for in October and November the angle of incidence of the sun's rays is much lower than in April and May when the sun is approaching its summer solstice. Figure 1 is a graph of soil temperature taken at Fredericton, New Brunswick, and even though the absolute values do not apply to southern Nova Scotia, the overall pattern and relative values certainly do. The slope of the temperature gradients is the most interesting aspect. From October to March inclusive the surface of the ground is cooler than its depths so that any emerging hatchlings would be digging upwards into colder soil. This would be a negative temperature gradient as far as the hatchlings are concerned. In April, however, the gradient would be positive with surface temperatures of the soil warmer than at the nest level. Note also that the daily spread between the morning and afternoon temperatures at the 10 cm level (3 15/16 inches) increases greatly in April and begins to lessen in September. It is also apparent by the slope of the morning temperatures that heat loss at night begins to increase in August and by October has pressed the soil temperature gradient to the left of the vertical. For six months only, as far as the hatchlings are concerned, is the mean temperature gradient to the right and thus positive. If hatchlings are reacting to this gradient, this might explain how they can hatch in the nest in October or November but not emerge until the following April or May when absolute soil temperatures may actually be colder but the soil surface is relatively warmer. I would suggest, therefore, that because reptiles in general tend to move towards warmer temperatures when placed below their optimum temperature, this means in northern latitudes a seasonal retreat into the substratum be it land or water. Thus turtle hatchlings in October will not dig upwards when the ground above the nest is colder than below and they are physically unable to dig down and therefore are "trapped" in the nest. They survive any subfreezing temperatures quite accidentally because of their yolk reserve which lowers the freezing point of their tissues beyond that of adults of the same species.

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## SUMMARY

New data have been gathered on *Clemmys insculpta*, *Chrysemys picta*, *Chelydra serpentina* and *Emydoidea blandingi* in Nova Scotia. *Clemmys* is more common where the other three species are rare, and it could not be found in southern Nova Scotia where the others are most common. Specimens of *Emydoidea* from a relict population in southern Nova Scotia have been sought after since 1953 and the results of each field party are summarized in tabular form. Twenty-four specimens have been recorded. Stomach analysis showed aquatic insects and snails as major food items. Evidence for overwintering of the eggs of *Chrysemys* and *Chelydra* is given. This topic is discussed in general and a theory advanced that overwintering of hatched turtles in the nest is due to the fact that ground surface temperatures of

October and November are relatively colder than nest temperatures and the turtles will naturally avoid the colder end of temperature gradient when placed below their optimum temperature. In spring hatchlings move upwards in response to warmer soil surface temperatures. The incubation of a *Chrysemys* and an *Emydoidea* nest were observed under identical conditions and the hatchlings emerged in 277 days and 88 days respectively, indicating a faster embryonic developmental rate in the larger *Emydoidea* eggs.

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# SOME ASPECTS OF BEHAVIOR OF A BIGHORN HERD*

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The object of this paper is to contribute to knowledge of group behavior and its variability in the bighorn. Although several authors give average group size for bighorn sheep, seasonal and sexual variations in group size are not well documented. Bighorn sheep are latitudinally widely distributed. Data presented concerning rutting, lambing and migration will help to fill in the broader picture of these activities throughout the range of the species and form a basis of comparison between the California race and other races. Diurnal activity patterns of bighorn sheep are largely unknown and not quantitatively described. It is felt that an effort to quantify such aspects as group dynamics, group composition and diurnal activity patterns will lead to more objective comparisons between herds and races of bighorn sheep and between bighorn sheep and other ungulates.

The present observations were made during an ecological study of a herd of California bighorn sheep (*Ovis canadensis californiana* Douglas) (Blood 1961). The herd is located in the Ashnola River region of southern British Columbia and consisted of about 250 sheep in 1961. Data were collected from May, 1960, through June, 1961.

## Description of Area

The principal study area lies adjacent to the 49th parallel of latitude and is bisected by the 120th meridian. The intensive part of the study took place on the lower watershed of the Ashnola River about ten miles from its confluence with the Similkameen River.

The Ashnola bighorn herd can conveniently be divided into two units having winter range on either side of the Ashnola River. From 150 to 175 sheep winter east of the Ashnola River, primarily on the South Slope Range, and 60 to 100 winter west of the river, mostly on the lower slopes of Crater Mountain (Figure 1). Most sheep in the herd are concentrated during the winter on an area of less than five square miles.

The Ashnola region is one of topographical transition, being located where the southwestern edge of the Interior Plateau of British Columbia intergrades with the Cascade Mountains. Locally the Okanagan Mountains interrupt the plateau surface and several peaks reach 8,500 feet in height.

The climate is largely determined by the presence of a mountain barrier to the west and by the rugged topography of the region itself. The whole area is relatively dry because of the "rain shadow" effect of the Coast Ranges. In addition, local climate is strongly influenced by differences in elevation and exposure. Snowfall is light on the winter ranges but increases markedly with altitude. Winter temperatures do not often fall below 0°F.

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Due to the great relief of the area much of the vegetation occurs in a series of elevational bands. True grasslands are mostly confined to the main valleys at elevations below 2,500 feet, but on southerly exposed mountain slopes edaphic climax grasslands may extend to considerable elevation and even merge with the alpine grassland. The grasslands belong to the bunchgrass type of the Pacific Northwest. Bluebunch wheatgrass, *Agropyron spicatum* var. *inerme*, is the principal grass species.

The forested areas, which occupy the greater part of the region, fall naturally into three zones: ponderosa pine, Douglas fir and spruce-pine. These correspond generally with the ponderosa pine-bunchgrass, Interior Douglas fir, and subalpine Engelmann spruce-subalpine fir bioclimatic zones of Krajina (1959). The ponderosa pine zone is not well developed. At intermediate elevations the Douglas fir zone is extensively represented. The climax tree cover is Interior Douglas fir, *Pseudotsuga menziesii* var. *glauca;* but due to widespread fires a large part of the zone is now occupied by lodgepole pine, *Pinus contorta* var. *latifolia*. The dominant understory is pinegrass, *Calamagrostis rubescens*. A spruce-pine zone is situated above the Douglas fir zone in a climate which is cool and relatively moist. The climax dominant here is Engelmann spruce, *Picea engelmanni*, which occurs commonly from 5,500 to 7,000 feet in elevation. Lodgepole pine is commonly associated with the spruce. Blueberry, *Vaccinium scoparium*, is the dominant understory in the subalpine zone.

Treeless alplands commence at 6,800 to 7,000 feet in elevation. They are among the driest alpine areas of the province. The climax vegetation is a grass-sedge complex with alpine sheep fescue, *Festuca ovina* var. *brachyphylla*, and alpine bluegrass, *Poa alpina*, being the dominant grasses. Dwarf willow, *Salix nivalis*, and white dryas, *Dryas octopetala*, form a thin mat on rocky areas.

## METHODS

Travel in the field was both on horseback and on foot. When possible, size, composition and activity of all sheep groups observed were recorded as well as date, time and exact location. Observations were made with a 10 by 50 binocular and with the unaided eye.

Groups of sheep were classified into three types according to their composition – ram groups, ewe groups and mixed groups. Ram groups contained males only. Ewe groups always contained ewes, usually in company with lambs and yearlings. They could also contain two- or three-year-old rams. Mixed groups contained both mature ewes (two years old or older) and mature rams. Rams four years old and older were considered mature. The nature of the mixed groups is essentially matriarchal, nevertheless they were classified separately.

It was not always possible to completely classify sheep groups to sex and age. Under favorable conditions of observation, yearlings could be distinguished but not always with complete certainty. Two-year-old ewes could not be distinguished readily from older ewes, even at close range. Two-year-old rams however, often found with ewe groups, were obvious by their horn

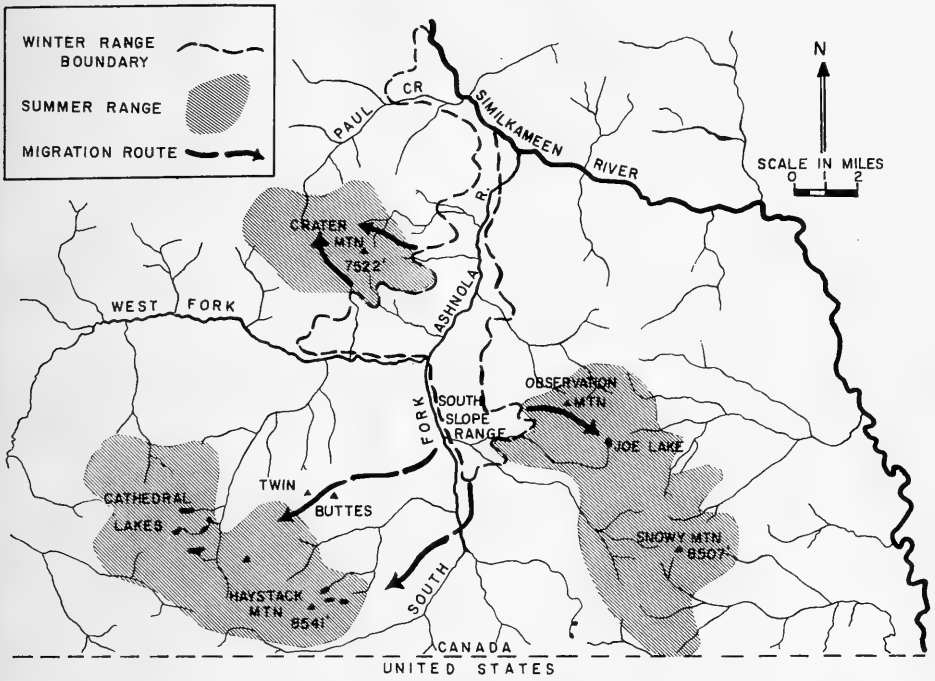


FIGURE 1. Map showing seasonal bighorn distribution and migration routes in the Ashnola region. Winter range outlined is the maximum area used from November through May. Summer range areas shown are regions of intensive summer use and are not likely the maximum summer range.

size. Three- and four-year-old rams could also be aged fairly accurately by horn size, however no attempt was made to determine age of rams older than four years.

To obtain daily activity data I sat atop a ridge overlooking a large grassy basin frequented by sheep on the South Slope winter range. Numbers of sheep visible, active (standing, walking, grazing) and not active (lying), were recorded every fifteen minutes from dawn until dark. The figures were then averaged over one hour periods. Sheep were observed from distances of 350 to 1000 yards and appeared to be unaware of my presence.

A limitation of the present study is that I was usually not able to identify individual sheep.

## MIGRATION

The pronounced relief of the area reduces the necessity of long seasonal migration for the herd. All sheep in the area appear to occupy separate summer and winter ranges, but in some cases there is no distinct division between the two. In general, the annual distribution of the herd shifts from summer range in the alpine and subalpine zones at roughly 6,000 to 8,500 feet elevation, to winter-spring range on southerly exposed parts of the Ashnola River trench,

between the 2,500 and 5,500 foot elevations. The winter ranges are mostly edaphic climax grassland slopes within the Douglas fir zone. Summer and winter ranges of the herd and migration routes are shown in Figure 1.

As classified by Urquhart (1958), Ashnola bighorns undertake a seasonal or annual remigration, since they return to the same range each year and the movement is closely related to the changing seasons. The seasonal remigration has an altitudinal basis. The seasonal movements undertaken by the herd are true migrations, comparable in all respects to the altitudinal migrations of mule deer, elk and moose in mountainous areas.

Wild sheep exhibit considerable variation in migratory habit. Murie (1944) has noted that Dall sheep, *Ovis dalli dalli*, are migratory in Alaska. Menez (1961) describes similar seasonal movements of the Baja California bighorn, *O. canadensis cremnobates*, near the southern extreme of bighorn distribution. Both Mills (1937) and Davis (1938) found Rocky Mountain bighorns, *O. c. canadensis* to be migratory in Yellowstone National Park, although both fall and spring migrations were not always complete. Smith (1954) and Couey (1950) describe true migrations of Rocky Mountain bighorns in Idaho and Montana respectively. Honess and Frost (1942) state, however, that "seasonal migrations of bighorn sheep are almost non-existent in the present-day herds of Wyoming." According to Green (1949), there are no well defined seasonal movements of bighorns in Banff National Park, Alberta. However Cowan (1944), in a more extensive study, found that most herds in Banff and Jasper Parks had separate summer and winter ranges. Sugden (1961) describes both migratory and non-migratory herds of California bighorns in the Chilcotin region of British Columbia. A herd with no available alpine range spent the entire year within a few square miles.

*Spring migration*

Rams of the Ashnola herd left the winter range before ewe groups both in 1960 and 1961. This is contrary to the migratory pattern reported by Spencer (1943) for the Taryall herd in Colorado. There, the older ewes were the first to leave the winter range, and were mostly found in the high country, where lambing takes place, by May 15. Rams and "young sheep" reportedly follow at a later date. Most investigators, however, have found that rams usually leave the winter range before ewes, and that sequence appears to be most characteristic of the species.

The spring migration of Ashnola rams is a gradual drift from the winter range. Rams start moving into the subalpine zone in late May and proceed into the alpine zone by late June, following the appearance of new spring forage on southerly exposed mountain slopes. At this time large snow drifts are still present on north facing mountainsides.

The spring migration of ewe groups is more of a distinct exodus than that of the ram groups. At lambing time considerable snow is still present on the alpine ranges and it appears that for this reason lambing takes place on the winter range. Ewe groups do not usually migrate until early July, well after the lambing period. Rocky Mountain bighorn ewes studied by Couey (1950)

TABLE 1. — Census figures showing movement of bighorns from South Slope in 1960.

| Number of sheep remaining on South Slope. | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MAY | | | JUNE | | | | | | | | JULY | | | |
| DATE | 28 | 29 | 30 | 8 | 12 | 13 | 15 | 16 | 17 | 24 | 30 | 6 | 10 | 11 | 14 |
| Ewe groups | | | | | | | 104 | 100 | 90 | 99 | | 60 | 40 | 9 | 0 |
| Ram groups | 42 | 60 | 14 | 17 | 15 | 5 | 0 | 10 | 0 | 13 | 6 | 0 | 0 | 0 | 0 |

in Montana, migrated from the winter range in late April and in May, previous to lambing, as did those observed by Wishart (1958) in Alberta. It appears that ewes which lamb on the winter range do not migrate until considerably later than those which lamb in alpine-subalpine areas. In either case, however, rams usually precede ewes in their spring migration.

The progressive migration of sheep from South Slope, the main winter range unit, is shown in Table 1 for the spring of 1960. The pattern was similar in 1961. Ewe groups of thirty-two and seventy-five animals were observed on alpine range at about 8,000 feet in elevation near Cathedral Lakes on July 9 and July 12 respectively. No sheep could be found in the area on July 7 and 8. Thus the ewe groups migrated almost entirely within a two- or three-day period. The first ewe group seen on summer range west of the Ashnola River in 1960 was a group of forty-one on July 8. Apparently ewe groups east and west of the Ashnola River migrated about the same time.

*Fall migration*

The autumn migration to lower ranges usually occurs from mid to late October, with most ewe groups preceding the rams. In 1960 the first sheep observed on winter range in the fall, a band of nineteen ewes, lambs and yearlings, were seen on October 10. All appeared in excellent condition. The first ram observed on winter range in the fall, a lone individual, was seen on October 23. By then over forty ewes, lambs and yearlings were in the vicinity. Most rams returned about October 30.

No rams were seen on the winter ranges in July, August or September. From early July until early October only one ewe group was seen on the winter range. That group of twelve ewes, lambs and yearlings fed for several days in late August on green growth around springs on the South Slope range, then disappeared. Smith (1954) observed a few bighorns in Idaho on low winter ranges throughout the summer. They were mostly ewe groups.

*Habitat selection*

Summer and winter ranges west of the Ashnola River are relatively contiguous and sheep only migrate from two to five miles. Both ram and ewe groups were observed on alpine range there, but not in close proximity. East of the Ashnola River, where larger numbers of sheep are found, a differential

migration of the sexes takes place. The Observation Mountain-Joe Lake range, located east of the main winter range, is used almost exclusively by rams, while alpine range around Haystack Mountain and Cathedral Lakes, south of the winter ranges, is a preferred area of ewe groups. During the study only one ewe group was seen in the former area and only one ram group in the latter. The two areas are separated by the South Fork of the Ashnola River. McCann (1956) also noted that ewe and ram bands in the Gros Ventre herd of Wyoming remained entirely separated by occupying different parts of the high summer range.

Although Ashnola rams do migrate up to fifteen miles, most of their ranges are relatively contiguous and migrations average five or six miles. Assuming that alpine-subalpine areas are desired as summer range by the sheep, it seems logical that the rams, which migrate earlier, should seek the nearest and most accessible summer range. That the ewe groups migrate eight to twelve miles across an unsuitable, timbered intermediate range, when alpine range exists within two miles of the main winter range, requires a different explanation however. The ewe migration also involves crossing the South Fork of the Ashnola River. Differences in topography of the ram and ewe summer ranges suggest that protection of lambs is a significant factor in summer range selection of ewe groups. The area occupied by the rams is largely one of rolling mountains, while the area chosen by the ewes is much more precipitous and of generally higher elevation. This is contrary to the suggestion of Williams (1925) that areas frequented by bighorn rams "are generally of higher altitude and of a more rugged character than those that the ewes frequent."

Post-rut habitat selection also suggests a difference in the importance of escape terrain to ewe-lamb and ram groups. Most ewes and lambs had ready access to precipitous, rocky escape terrain throughout the winter. No ewe-lamb groups were observed within five miles of the settled Similkameen River Valley, into which the Ashnola River flows. But rams were commonly observed on the lower Ashnola River ranges in close proximity to the Ashnola Road. Only rams inhabited the Paul Creek Range on the slopes of the Similkameen Valley. Up to twenty-five rams used that slope from December through March, and could see and hear passing traffic on the Southern Transprovincial Highway as well as frequent vehicles on a farm road which dissected the lower edge of the slope itself. Rams seem more tolerant of certain aspects of civilization than are ewes.

The selection of largely separate summer, late winter and spring ranges by Ashnola ewes and rams appears to result from a positive affinity possessed by them for different environmental conditions, with ewes usually selecting habitat with more readily available escape terrain than that selected by rams.

This is supported by observations of Cowan (1944) who found that ewes without lambs, and thus presumably not as desirous of escape terrain as ewes with lambs, were often seen on ram summer range. However, Lawson G. Sugden (personal communication) found little consistency in the precipitousness of terrain occupied by ewes or rams in the Chilcotin region of British Columbia. Therefore the above explanation for the use of separate ranges by

Ashnola rams and ewes may not apply to bighorn sheep in general. It is possible that some form of intersexual intolerance may also play a part in keeping ram and ewe groups separated during much of the year.

*Motivating factors*

Although migrations of montane mammals are common, the factors motivating such movements are not fully understood. That sheep must leave the alpine summer ranges each fall is obvious at such latitude as that of British Columbia. However it is the spring migration, which sheep are not compelled to make, that needs an explanation. Presumably the ultimate factor involved is of survival value; otherwise natural selection would eliminate such a habit. In that, I agree with Edwards and Ritcey (1956), who consider that altitudinal migrations are undertaken by animals to make use of different environments so that adverse conditions experienced are reduced to a minimum.

The actual stimulus to spring migration appears to involve several factors. Plants on the winter range remain succulent until July, but the rams start their spring migration before that time. They are probably seeking vegetation in its most nutritional early growth stages, and thus follow the appearance of new growth altitudinally. By the time ewe groups leave the winter range, temperatures are high and herbaceous growth is beginning to mature and dry out. In early July, 1960, temperatures at Keremeos in the Similkameen Valley (elevation 1000 feet) had reached the mid-nineties, and were only slightly lower on southerly exposed slopes of the winter range. High temperatures then, by affecting the animals directly, and indirectly through their effect on the vegetation, are suggested as the factor stimulating ewe groups to migrate to the alpine ranges, which they have learned from past experience yield succulent forage in mid-summer. Orientation of the new lamb crop each year is no problem, since in a social species like the bighorn the young merely accompany their experienced elders. Annoying insects were more abundant on summer ranges than on winter ranges and are not thought to be a stimulus to spring migration.

Snowstorms in the alpine-subalpine zone occur as early as late August in the Ashnola region, but are ephemeral in nature and do not force the sheep back to the winter range. In 1960, the fall migration corresponded with the arrival of permanent snow on the summer range. Such snow readily covers the low vegetation utilized by sheep on those ranges. As breeding does not take place until the sheep return to the winter range, the fall migration could be partly motivated by a reproductive urge. The fall migration appears to be motivated by a combination of the gametic, alimental and climatic incentives of Heape (1931).

*Local drifts*

Two notable non-migratory changes in distribution of the herd were evident. About mid-August the rams, and to a lesser extent the ewes, descended from the open alpine slopes into the subalpine zone, largely on northerly exposed slopes. By following new spring growth altitudinally and then

moving on to alpine-subalpine northerly exposed slopes in late summer, the sheep are able to eat vernal vegetation over a six-month period.

After the breeding period, during which most of the herd is concentrated on the larger ranges such as South Slope, there is a dispersal of ram groups to smaller, more disjunct, open slopes along the lower reaches of the Ashnola River. At this time the sex ratio on the South Slope range becomes decidedly weighted in favor of females. The ewes and their followers prefer to remain near traditionally used areas of escape terrain throughout the winter and spring.

## GROUP DYNAMICS AND COMPOSITION

### *Spacing*

The Ashnola herd, during both summer and winter, was split into various smaller bands. In some cases these were separated by as much as fifteen miles. Population density was significantly greater on the winter range than on the summer range. That is attributed to the restricted area of available winter range. An average of 110 sheep used the South Slope winter range from late October, 1960, through June, 1961. That represents a density of fifty to sixty sheep per square mile. Those sheep consisted of numerous smaller groups in close proximity. On the summer range, however, bands of sheep were spaced at wider intervals, usually one to four miles. Repeated observations indicated that groups of relatively constant size maintained home ranges on particular ridges and mountains throughout most of the summer. This tendency for at least a general spacing of bands on the summer range, where abundant suitable habitat exists, appears to be a result of some form of social intolerance as suggested by Buechner (1960:93). The home ranges are not actively defended and cannot be considered as territories.

### *Group size*

The bighorn sheep is one of the most social of North American big game species. The number of sheep comprising each of the 557 observations made between May 1, 1960, and June 30, 1961, varied from solitary animals to a band of seventy-five. Average group size based on 490 observations from May 1, 1960 to April 30, 1961 was 9.3 animals. On areas of relative sheep abundance, such as South Slope, alarmed sheep tend to band together, and as many as 140 have been counted in one group after the observer walked across the middle of the slope in plain view of them. Therefore alarmed groups were only recorded if it was obvious that they had not joined other groups.

Group sizes, based on the 557 observations, are indicated in the following tabulation:

| Group size: | Single | 2-4 | 5-9 | 10-19 | 20-29 | 30-39 | 40 + |
|---|---|---|---|---|---|---|---|
| No. of obs.: | 44 | 157 | 163 | 135 | 35 | 12 | 11 |
| % of total: | 8 | 28 | 30 | 24 | 6 | 2 | 2 |

Of the twenty-three groups in the 30-39 and 40+ categories, only one was a ram group. Twenty-eight of the forty-four lone individuals were rams, of

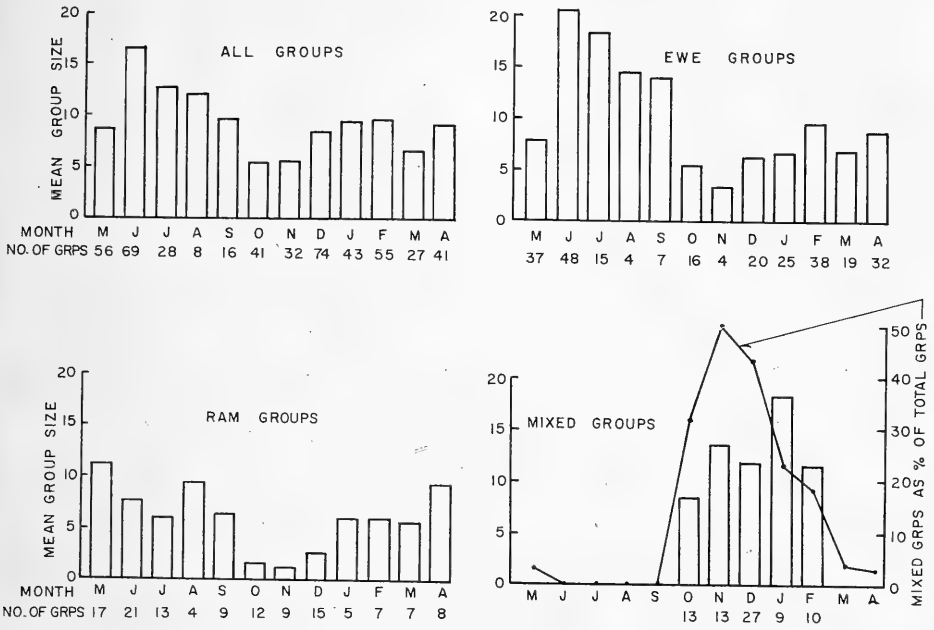


FIGURE 2. Seasonal changes in grouping of bighorn sheep on Ashnola ranges, May 1960 through April 1961.

which twenty-three were four years old or older, three were three years old and two were two years old. Thirteen of the single observations were ewes, two were yearlings and one was unidentified. The large percentage of lone mature rams indicates that they are the least social members of the herd. Both Smith (1954) and Wishart (1958) recorded about twice the proportion of single individuals to total groups seen on Ashnola ranges. Most observations of lone sheep made by Smith were of rams, while those of Wishart were predominantly yearlings. The average group size of 9.3 for Ashnola bighorns is similar to that of 8.9 recorded by Wishart in Alberta, and only slightly higher than the average of 7.3 reported by Smith in Idaho. The extent to which average group size may vary with population density is not known however, and it is therefore difficult to make valid comparisons between herds.

On winter ranges of relative population concentration there were, in a sense, no definite sheep groups. Fluctuations in group size and composition were frequent on such areas as groups split and rejoined, especially during the rutting period. At other seasons numerous combinations of sexes and ages formed relatively stable groups. Some ram groups on small, disjunct wintering slopes remained constant in size for over two months in late winter and early spring.

Figure 2 shows variation in group size of Ashnola bighorns by months. Ram, ewe and mixed groups vary considerably in their dynamics. Ewe groups were largest in June immediately after lambing. That is attributed to the

highly social nature of the lambs which appeared to exhibit more affinity for one another than for their mothers. Gregariousness in ewe groups remained at a high level on the summer range, but dropped greatly during the rut. After the rut, ewe group size remained relatively constant until lambing. The average size of ewe groups in May could be slightly biased in favor of large groups, since during lambing many lone ewes are in rough terrain and are not as easily observed as the larger groups on the open slopes. Mean size of ewe groups for the entire year was 10.7 animals. Observed ewe groups ranged in size from one to seventy-five sheep.

Ram groups were largest in the spring and smallest from October to December. In many cases however, not enough groups were seen to yield reliable averages. Ram groups during the rutting period usually consisted of one or two individuals travelling between ewe or mixed groups. On the summer range ram groups were considerably smaller than ewe groups. Mean size of 127 ram groups observed from May, 1960 through April, 1961 was 6.1, also smaller than for ewe groups. Ram groups of fifteen or more individuals were frequently observed in the spring. The largest ram group seen on the winter range contained thirty-three individuals (May, 1960). Most were four years of age or older. The largest ram group recorded on the summer range contained twenty-two rams. Jones (1950) found California bighorn rams most commonly in groups of two or three, and saw none larger than twelve. His observations however, were confined to summer and autumn.

Significant numbers of mixed groups were seen only from October until February. Those groups were considerably larger than ram or ewe groups observed during the same month. Average size of seventy-two mixed groups for the period October, 1960, through February, 1961, was 12.6 sheep.

Several authors describe increased gregariousness of bighorn sheep during the breeding season. In the Ashnola herd some large mixed groups were observed during that period, but numerous smaller, usually unisexual "groups", such as lone rams travelling between ewe groups, weight the average size downward considerably. However, if we assume that single sheep are merely on their way to join a group, and only consider groups of two or more in calculating average group size for the months of the rutting period, then the average group size is much greater. This would give an impression of increased gregariousness during the breeding period.

Frequency distributions of group sizes by three month periods are presented in Figure 3. The distributions of ram, ewe and mixed groups vary considerably with time, being most dissimilar during the rutting period. At that time most of the rams and ewes are in mixed groups and strictly ram or ewe groups are few in number and small in size. Ram and ewe groups showed similar size distributions in winter and spring.

*Composition*

During the period May 1, 1960 to June 9, 1961, 107 ram groups and 234 ewe groups were completely classified to determine their composition. Those data are summarized in Figure 4.

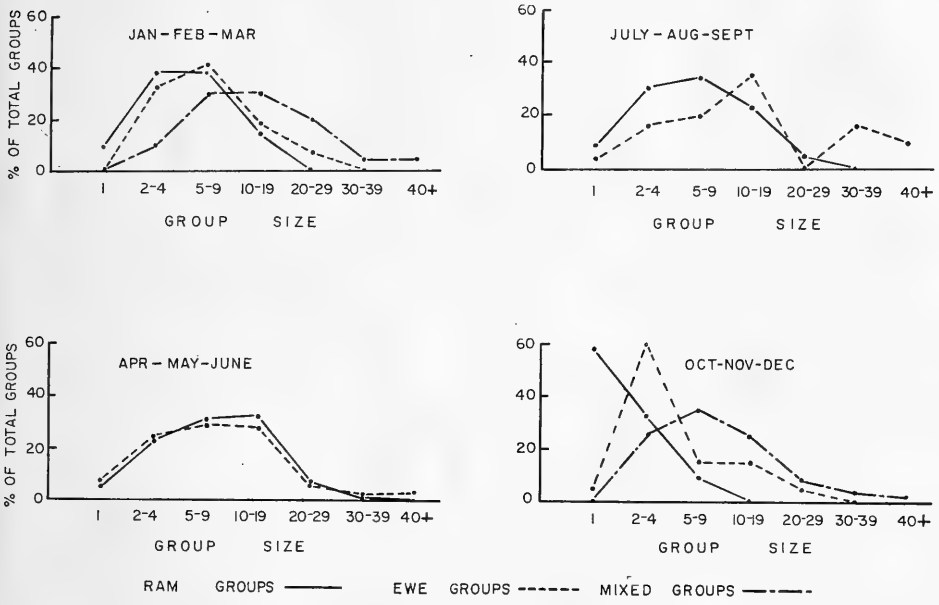


FIGURE 3. Frequency distributions of Ashnola bighorn sheep group sizes by three month periods.

No lambs were observed with ram groups. Only three of the ram groups contained yearling sheep (sex undetermined) and those were on the winter range. A large percentage of the ewe groups contained yearlings. Two-year-old rams were slightly more common in ewe groups than in ram groups. Conversely, three-year-old rams occurred in 37% of ram groups but in only 9% of ewe groups. Green (1949) states that, "young rams remain with the ewes until about four years of age." This does not generally agree with my observations of two- and three-year-old rams.

Only 12% of Ashnola ewe groups contained mature ewes only. Over half of those were lone ewes. Over 50% of the ram groups contained mature rams only. Those groups varied considerably in size.

Several seasonal variations in group composition are evident when the above observations are divided into three month periods. While three-year-old rams were found in about 60% of ram groups in the spring (April through June), they were only found in 35% of such groups after migration to the summer range. Similarly, two-year-old rams dropped from 36% to 10% in the same period. Conversely, ewe groups containing two- or three-year-old rams or both, were low in the spring but increased two to threefold on the summer range. No rams over three years of age were observed with ewes on the summer range. The shift of many two- and three-year-old rams from ram groups on the winter range to ewe groups on the summer range could be due to either increased intolerance toward them by the older rams or to an

increased attractive force between them and the ewes. In view of the earlier spring migration of ram groups, the former explanation appears more plausible.

Mixed groups were commonly observed only during the October-December period; however, a few were seen as late as May (Figure 2). Jones (1950) and McCann (1956) who studied California and Rocky Mountain bighorns respectively, also observed most mixed groups during the rut. The first mixed group observed in the Ashnola herd in the fall was seen October 25. Mixed groups as a per cent of total groups observed, reached a peak in November corresponding with the peak of rutting activity. The frequency of occurrence of mixed groups did not drop as quickly after the rutting period as it rose before it, indicating a gradual movement of rams away from the ewe groups as winter progresses. McCann (1956) also noticed that a few rams prolong the association with ewe groups.

Distinctly different social aggregations were noted during the rutting period. Only three of thirty-three ram groups observed during that period contained two or three year old rams. Similarly the number of ewe groups containing yearlings was low. That was because most yearlings and young rams were with mixed groups.

## Reproductive Behavior

*The rut*

The peak of mating activity occurred from mid to late November. The earliest observation of a ram in rutting condition was made on October 13, 1960, on the winter range. The ram ran for 300 yards across an open slope directly toward me, finally stopping only twenty yards away. He exhibited the typical swollen neck of rutting rams, and was uttering a nasal grunt lasting about two seconds, repeated at twenty to thirty second intervals. His tongue protruded as he grunted.

Mature rams during the rut, either alone or in small groups, did not display the fear of man which was evident at other times of the year. Mixed and ewe groups however, were as wary during the rut as at other seasons.

Four rams were observed chasing a ewe on February 6, 1961, long after the peak of breeding activity had passed. The ewe appeared to be in estrus and the chase went on intermittently for about one hour. Copulation was not observed, however, and the group eventually moved from view. That was the latest observation of sexual activity in the herd, and it indicates that the rutting period may be rather extended.

Rams three years of age and younger usually displayed only casual sexual interest in the ewes. One three-year-old ram, however, copulated with a ewe only a few seconds after she had been mounted five times by an older ram. Breeding habits of bighorn sheep have been described by several authors (Mills 1937, Spencer 1943, Couey 1950, Smith 1954). In general, sexual activity of Ashnola bighorns was more subdued than that described by those authors. The number of rams pursuing ewes in estrus was not usually more than four or five. Headlong pursuit of ewes over rugged terrain was the exception rather

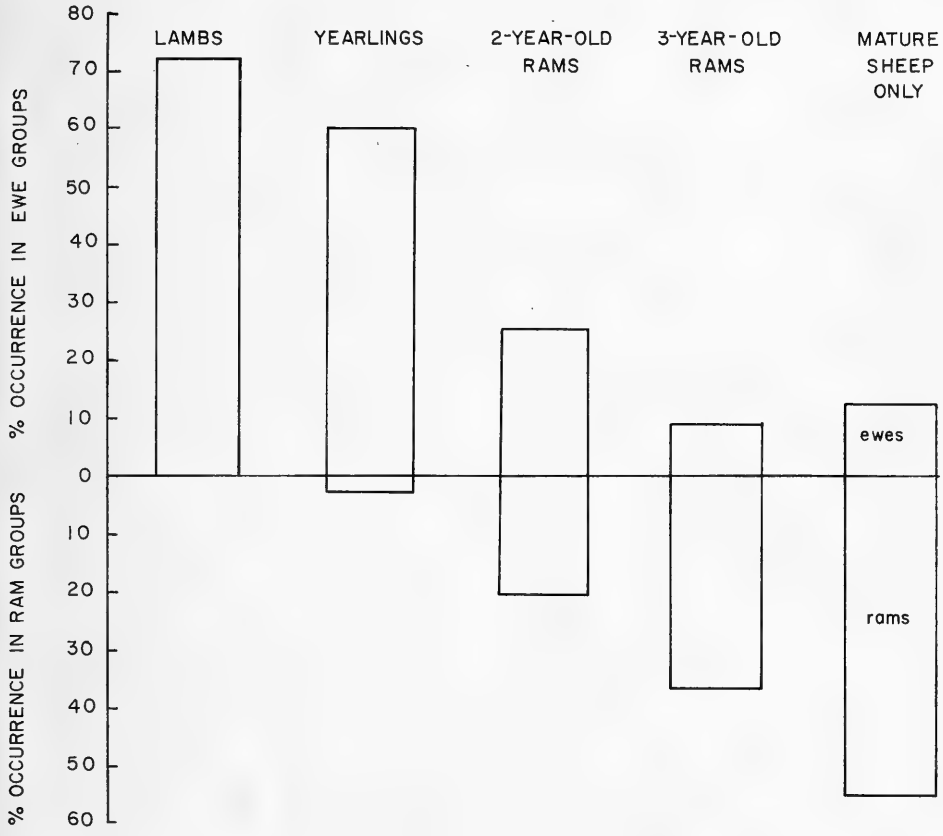


FIGURE 4. Composition of 107 ram groups and 234 ewe groups, shown as the percent of ewe or ram groups containing the various sex and age components indicated.

than the rule. Usually such groups ran rather slowly and avoided precipitous areas. Often the receptive ewe ran only a few yards before being mounted.

Jousting of rams was observed in November and early December, but also lacked the violence described by several observers. No "battles royal" mentioned by Spencer (1943) were observed. Serious ram bouts were not seen after early December, although playful butting was observed throughout the year. No evidence was found of injury or serious physical depletion as a result of breeding activity. Lawson G. Sugden (personal communication) also noted that California bighorn rams west of the Fraser River in British Columbia did not have fierce battles. It appears that the race *californiana* may be typified by more subdued breeding activity than that found in the *canadensis* race.

Two ewes observed on December 6, 1960, were engaged in a serious jousting match. Both ewes had lambs with them and were in a group of twelve sheep, three of which were mature rams. The ewes had six head-to-head encounters over a twenty minute period, each with a loud report. During that

TABLE 2. — Spring lamb counts for South Slope Range

| | Number of lambs observed | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MAY | | | | | | | JUNE | | | | |
| DATE | 2 | 7 | 10 | 17 | 19 | 23 | 25 | 1 | 8 | 13 | 15 | 17 |
| 1960 | | 4 | 6 | 5 | 6 | | | 12 | 16 | 20 | 31 | 35 |
| 1961 | 2 | | 5 | | | 5 | 16 | 22 | | | | |

time a mature ram tried to mount one of the ewes. The ewes were observed from fifty yards with ten-power binoculars so were not misidentified. I have been unable to find reference to any other such serious bouts between ewes, although Green (1949) found that among Rocky Mountain bighorns at Banff, friendly jousts were not unusual in either sex.

*Lambing*

First lambs observed in 1960 and 1961 were four on May 7, and three on May 2 respectively. They were on the South Slope range at the edge of escape terrain and were judged to be about one week of age. Table 2 shows numbers of lambs observed on South Slope in 1960 and 1961. The numbers probably do not correspond exactly with lambing intensity, since most of the lambs appeared to be one to two weeks of age when they came out of the lambing bluffs with their dams. The lambing period extends from late April until mid June with a peak in late May. One small lamb observed on the summer range was probably born in July.

Lambing ranges of the herd all embody similar characteristics. They are precipitous and liberally covered with cliffs and rock outcroppings. Most are between 3000 and 5000 feet in elevation and the warmer and drier southerly exposures are selected. Almost invariably the lambing bluffs are immediately adjacent to grassland slopes used as spring range. A few are partly forested.

For the first few weeks after birth the ewe-lamb groups used only a fringe of spring range adjacent to the lambing bluffs. Often they would only venture a few yards from such escape terrain and hastily flee for cover at the slightest disturbance. Throughout the study it was noted that adequate escape terrain in proper juxtaposition with grassland slopes is a prime requisite of bighorn habitat selection, particularly of ewe-lamb groups.

The first lambs observed in 1961 were already eating some plant food, but also nursed frequently. As the lambs grew older both frequency and duration of nursing periods decreased. Lambs were never seen to nurse for more than thirty seconds and usually the period was much shorter. Mean duration of ten nursing periods was sixteen seconds. As noted by Smith (1954), the feeding period was always terminated by movement of the ewe; the lambs never stopped suckling voluntarily. The latest observation of successful nursing in

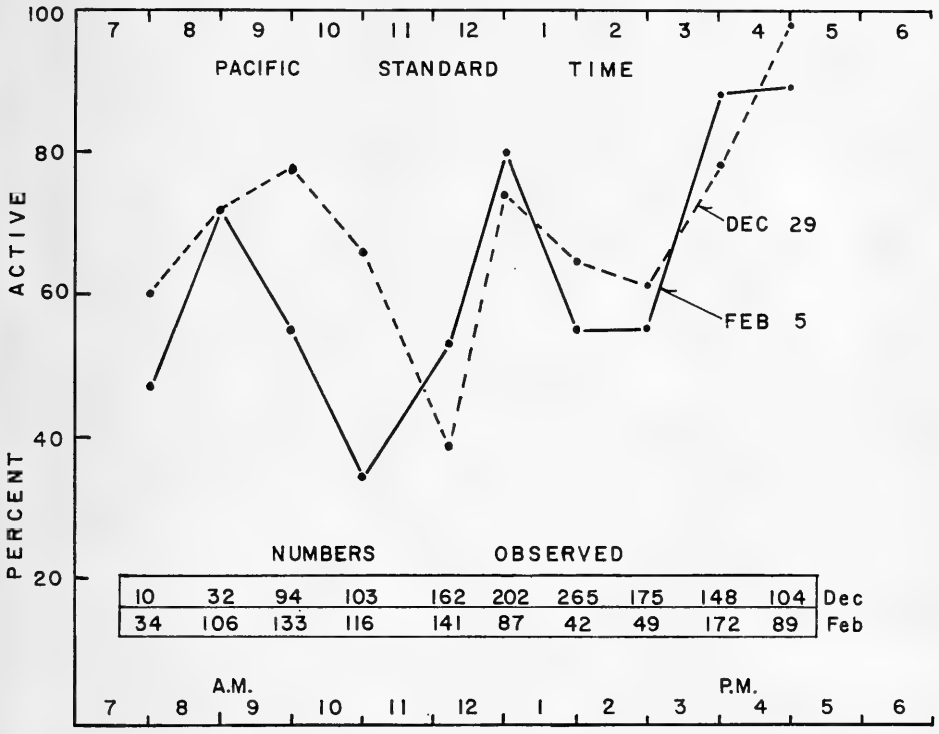


FIGURE 5. Activity rhythm of bighorns in winter from shortly after dawn until nightfall. December and February observations were both made at the same site.

1960 was made on October 10; however, an attempted nursing was observed on December 6. Lambs appear to be weaned by the time they are five or six months old.

## DIURNAL ACTIVITY

Bighorn sheep are largely diurnally active. One exception was apparent during this study. On two occasions during the rutting season the crashing reports of fighting rams were heard from one to two hours after nightfall. Activity appears to begin at dawn. General observation of the herd suggested that feeding periods alternated with periods of rest and loafing for any particular group. However, groups of various sizes were commonly seen either resting or feeding at all times of the day. When fairly large bands were observed feeding there usually were one or more individuals bedded down among them and conversely other groups were observed in which all but a few sheep were resting. This applied to both ram and ewe groups.

To determine whether any general pattern of daily activity rhythm could be found, and if so, the number of feeding and resting periods involved, activity data were recorded from dawn until dark on two winter days. The data

were recorded on December 29, 1960 and February 5, 1961. No summer data are available. Data obtained are plotted in Figure 5. Times are Pacific Standard. Sheep observed for each one hour period are the sum of those seen at each fifteen minute observation within the respective hour. Since individual sheep are difficult to identify, no special records were kept concerning activity of individuals. Numbers of sheep observed in each one hour period varied considerably. More sheep were in the area of observation at midday than early or late in the day. That was because the basin observed was not generally used as an overnight bedding ground. At about 4:00 to 4:30 p.m. on winter days most of the sheep walked westward out of the basin toward more protective bedding areas. Sheep usually walked continuously while feeding, thus groups frequently entered and left my field of view. Nearly all of the recorded activity is feeding.

On December 29 the weather was clear, sunny and cool. Temperatures ranged from 30°F. to 36°F. Daylight came between 7:00 and 7:30 a.m. and ended about 4:45 p.m. The sun set at 3:35 p.m. February 5 was also clear and sunny. The temperature varied from 30°F. to 38°F. Daylight commenced about 7:30 a.m. and extended to about 5:15 p.m.

Three peaks of activity occurred (Figure 5), one near the beginning of the photoperiod, around 8:30 a.m., one about 12:30 p.m. and the third from about 3:00 p.m. until nightfall. Lows of activity were between 10:30 and 11:30 a.m. and 1:30 and 2:30 p.m. The pattern does not appear related to daily temperature change. Periods of feeding and rumination appear related to length of the photoperiod. Two complete periods of feeding and rumination occur between dawn and 3:00 p.m. Rumination following the last peak of activity probably occurs on the bedding ground.

Although other authors have suggested this pattern of activity for bighorns, it has not before been quantitatively shown. Mills (1937) found that in the summer, bighorn sheep in Yellowstone National Park had three peaks of feeding, interrupted by mid-morning and mid-afternoon resting periods. Davis (1938) describes a similar diurnal rhythm for the same herd. Smith (1954) also noted that considerable bedding occurred after both morning and midday feeding periods of Idaho bighorns. Three daily activity peaks have also been recorded for Moose, *Alces alces*, by Geist (1960). Davis and Taylor (1939) however, describe only one period of rest (midday) and two feeding periods (morning and late afternoon) for bighorns in Texas.

There is now a need for quantification of summer activity data. The above observations of Mills (1937) and Davis (1938) suggest that this would show lengthened, rather than additional, periods of feeding and rumination associated with the lengthened photoperiod.

## Summary

Observations were made of certain aspects of the behavior of a California bighorn sheep herd in Southern British Columbia from May, 1960 through June 1961. The herd undertakes a seasonal remigration having an altitudinal basis.

Annual distribution of the herd shifts from summer range in the alpine and upper subalpine zones to winter-spring range on southerly exposed edaphic climax grasslands altitudinally within the extensive Douglas fir zone. Ewe-lamb groups on both summer and winter range were noted to select habitat of a more precipitous nature, or with more ready access to escape terrain than that selected by ram groups.

Ram and ewe groups utilized largely separate summer, late winter and spring ranges and that separation appears to result from a positive affinity possessed by the sheep for different environmental conditions. Sheep groups on the summer range maintained a fairly constant spacing within the general area selected by each sex. This spacing is thought to be a result of some form of intolerance.

Average group size from 490 recorded observations was 9.3 sheep. Sizes of ram, ewe and mixed groups varied considerably through the seasons. Average size of ewe groups was 10.7, of ram groups was 6.1, and of mixed groups was 12.6. Mixed groups were only commonly observed from October until February.

Yearling sheep were very rarely found with ram groups, two-year-old rams were fairly equally divided among ram and ewe groups, while most three-year-old rams were observed in ram groups. Data indicate that many two- and three-year-old rams found with ram groups on the winter range, join ewe groups on the summer range. This may be a result of increased intolerance toward the young rams by the older rams at the time of the spring migration.

Both rutting and lambing activities were confined to the winter range and its vicinity. The peak of rutting activity in 1960 was from mid to late November. No physical depletion resulting from breeding activity was apparent. The lambing period in 1960 and 1961 extended from late April until mid June with a peak in late May. Lambs appeared to be weaned by the time they are five or six months old.

The winter pattern of diurnal activity was characterized by three activity peaks, one near the beginning of the photoperiod around 8:30 a.m., one at about 12:30 p.m., and the third from about 3:00 p.m. until nightfall.

## ACKNOWLEDGEMENTS

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# FACTORS LIMITING THE ADVANCE OF SPRUCE AT GREAT WHALE RIVER, QUEBEC*

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The following notes are derived from observations made at Great Whale River, on the east coast of Hudson Bay, in 1949. Publication was withheld at that time because of an expectation, repeatedly unfulfilled, of making complementary observations at inland sites. The current widespread interest in northern ecology suggests that these admittedly fragmentary observations may be of some value, particularly as they were made before human influences at this site became very serious.

Although black spruce (*Picea mariana*) is predominant a few miles inland, near the coast abundant sand favors white spruce (*P. glauca*), which accordingly supplies most of the seed and is dominant even in the bogs. Larch (*Larix laricina*) is present but not very abundant. These remarks apply chiefly to white spruce.

Some earlier observers were inclined to regard some single factor as all-important in preventing spread of trees into the barrens. Today most students will agree that we must think in terms of a complex of factors. When total attrition due to these factors equals total growth the trees cannot advance. The situation is complicated by the frequent interaction of factors. The effects are accordingly not purely additive.

Great Whale River is on a lee shore. Consequently some factors are more important than they would be inland or on a weather shore. The site is actually subarctic, but, as in many coastal situations, a narrow coastal strip is essentially barren. Large deposits of sand were laid down to depths of up to 200 ft. during emergence of the land at the end of the Pleistocene, and smaller deposits occur for several miles up and down the coast.

(1) Mean summer temperature is, of course, important, because it influences the total possible growth. The prevailing wind off the ice-laden water of Hudson Bay causes a steep upward temperature gradient as one moves inland. As the moist air moves in from the sea it need only be lifted a few feet to form persistent fog or low stratus. Looking under such a deck one may see continuous sunshine a few miles inland and at sea.

(2) Length of growing season. The cold winds off Hudson Bay delay the spring warming and shorten the effective season. Although the effect is slightly reversed in late summer, the water does not warm up enough to be of much value, and by early September all growth has stopped, whether from shortened day length or other factors is not clear.

(3) Lack of soil was emphasized by J. W. Marr (Ecological Monographs 18: 117-144, 1948), who worked mainly at Richmond Gulf, but also at Great Whale River. It is true that many of the glaciated granite hills and ridges have large expanses of bare rock. Yet the smallest pockets of soil often

*Contribution No. 271 from the Plant Research Institute, Central Experimental Farm, Ottawa, Ontario.

support small spruce; and on the raised delta there is unlimited soil that is often devoid of trees.

(4) Low soil fertility is probably of considerable importance, especially on the delta sand. While it does not prevent growth it must sometimes reduce its rate.

(5) Lack of water is probably of minor importance on this coast, but in dry seasons it certainly limits the growth of various plants on the sand deposits. Although large trees can presumably reach the water table at all times, seedlings are probably checked and injured by prolonged dry periods.

(6) Snow abrasion is very important on this coast, owing to the sweep of wind off the sea ice. Its importance is demonstrated by the absence of spruce on areas of level ground with ample soil, and their presence in the smallest pockets of soil on the lee slopes of granite ridges that cause the wind to eddy. The abrasive effect of the hard spicules of winter snow is shown by the well-known broomstick effect. Branches remain alive on the lowest foot or two of the trunk, which is snow-covered from early winter; but the blowing snow generally kills the lateral buds for the next three feet or so of trunk. Only if the leader happens to survive this treatment can branches be produced above this level. Anything that causes eddying reduces the velocity of the abrading snow crystals. If the terrain is unimpeded only the mutual protection of a group of trees can curb abrasion. When only few seedlings can become established, this problem is partly solved in white spruce, and rarely in larch, by the formation of clonal colonies. The lowest branches of a tree, protected by the snow, spread laterally for several feet; each may then send up one or more leaders. Thus we have in effect a small grove whose members afford each other substantial protection. Several of these "groves" occurred near Great Whale River, and in some of them secondary trees were well rooted and becoming independent.

(7) Sand abrasion. Although there can be relatively few days in the year on which the combination of wind, and dry, exposed sand permits drifting, sand abrasion is of striking local importance. Numerous small and a few large blowouts occur on the delta sand, the biggest being about one quarter mile in length. Partly because it operates in summer, the effect of sand abrasion on white spruce differs markedly in appearance from that of snow abrasion. It is too severe to allow the establishment of seedlings. If a blowout forms and moves toward an established spruce grove, all the trees on the side nearest the advancing sand are killed completely before there is any visible accumulation of sand at their bases.

(8) Limited seed dispersal into tundra. On this coast spruce seed must be transported against the prevailing west to northwest wind. The red squirrel and White-Winged Crossbill are unlikely to take seeds beyond the trees except where gulleys filled with willow and alder provide some cover. This factor would be of small importance but for its interaction with snow abrasion. Because snow abrasion increases with decreased density of spruce, any factor that reduces the number of seedlings also endangers the survival of those that do occur.

(9) Human activity. Old tent rings and flint chippings suggest that the river mouth was a native gathering place long before the establishment of the first trading post. The main attraction was presumably the seasonal concentration of white whales in the river mouth, which apparently teemed with fish until some forty years ago. The natives presumably cut some spruce, and their trails may have started some blowouts where they cut across old beach ridges on the raised delta.

(10) Difficulty in establishing seedlings in *Cladonia* ground cover. Although such white spruce as become established on a closed cover of *Cladonia* and other fruiticose lichens grow well, very few seedlings are seen. Consequently we find large expanses of very open spruce-*Cladonia* parkland. This is evidently not a purely climatic limitation, for the same association occurs far inland under more benign conditions. It is not clear whether the failure of seedlings to develop is due to a chemical inhibitor supplied by the lichens, or whether the lichen cover simply supplies a physical barrier through which the spruce seeds cannot easily fall. Various herbs and shrubs with quite small seeds also seem to have difficulty in becoming established in the lichen cover, which suggests a chemical effect. It would be interesting to know whether this extremely simple association was equally abundant in the Ungava Peninsula before decline of the caribou population.

(11) Insect pests and diseases. No insects seem to be an appreciable hazard to spruce at Great Whale River, although *Adelges* galls kill some twig tips. However, several rust fungi of the genus *Chrysomyxa* play a significant part. Three species are abundant enough to be serious at Great Whale River and two others may occur to a limited extent on this coast and elsewhere along treeline. Other species attack spruce further south. *Chrysomyxa ledicola*, whose alternate hosts are *Ledum groenlandicum* and *L. palustre* var. *decumbens*, is common everywhere at and near treeline and is a serious disease of spruce at Great Whale River. Seedlings must often grow up through a mat of *Ledum* and aecia may form on 75% of the new needles. As infected needles are shed late in the first summer instead of a year later, a heavy infection greatly reduces the vigor of the seedlings. *C. empetri*, with *Empetrum hermaphroditum* for its alternate host, occupies essentially the same ecological niche and is only slightly less serious. *C. woronini*, also harbored by the two species of *Ledum*, infects and kills the new growth of spruce branches. It is potentially very destructive, but usually only a few shoots are killed on any one tree. *C. ledi* var. *ledi* and *C. ledi* var. *rhododendri*, with *Ledum palustre* and *Rhododendron lapponicum* for alternate hosts, may also cause minor defoliation of spruce. All but *C. woronini* can persist and spread on their alternate hosts, and are found on them up to 300 miles beyond treeline.

Because alternate host plants harbouring spruce rusts commonly carpet the ground, rust spores are ready to attack seedlings that emerge anywhere beyond the closed forest. These rusts seldom if ever kill seedlings, but they constitute a serious drain on the vitality of the young plants and may so reduce their vigor that they are killed by snow abrasion or crowded out by other plants.

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# MARINE BIRDS IN THE GULF OF ST. LAWRENCE AND STRAIT OF BELLE ISLE DURING NOVEMBER

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The seabirds of the Gulf of St. Lawrence and Strait of Belle Isle region have attracted the interest of many ornithologists from the time of Audubon to the present day. However, although the chief breeding colonies along the North Shore, at Anticosti and at Bonaventure Island are now well documented (Lewis, 1924, 1931, 1937, 1942; Hewitt, 1960; Gabrielson, 1952; Lemieux, 1956), little has been published referring to the offshore waters and to seasons other than the summer. The standard works on the avifaunas of the neghbouring land masses contain little relevant information and, moreover, those most valuable general works on North Atlantic seabirds by Wynne-Edwards (1935), Rankin and Duffey (1948), and Fisher and Lockley (1954), are not concerned to any great extent with this small corner of the ocean. Wynne-Edwards (1935) points out that the bird population at sea in the Gulf of St. Lawrence is very sparse when compared to the neighbouring Newfoundland Banks. This is borne out by the observations presented here, although the large numbers of gulls attendant upon fishing operations partially obscures this.

My observations are a by-product of two fishery survey cruises I made on the research trawler *A. T. Cameron* of the Fisheries Research Board of Canada. On these cruises the ship operated in the Gulf of St. Lawrence and Strait of Belle Isle region during the periods November 7-29, 1960 and November 11-22, 1961. The areas where fishing operations were carried out, as well as other locations mentioned in the text, are shown in Figure 1. The fishing areas labeled A-E were visited in both years, but F, G and H were worked only in 1960. On eighty-one separate occasions estimates were made of the numbers of birds gathering around the ship as the trawl net was handled at the surface. These estimates, obtained under fairly uniform conditions of bird attraction, have been used as the basis for a comparison between the numbers of the various scavenging species occurring in the different areas (Table 1). The scavenging species are attracted to any object which might provide food, be it a school of whales or a ship, but the independent species such as the alcids require more intensive and time consuming observations to assess their true status.

The Strait of Belle Isle records were obtained while the ship was on passage from St. John's to the fishing areas in the Gulf of St. Lawrence. In 1961 the entire strait region was passed during the hours of daylight with good watching conditions, but in 1960 the straits were approached at night in unfavourable weather conditions when icing severely restricted visibility.

Oceanographically as well as ornithologically, the Strait of Belle Isle is a most interesting region, for it is here that two water masses with different temperature and salinity characteristics meet. A cold inshore branch of the

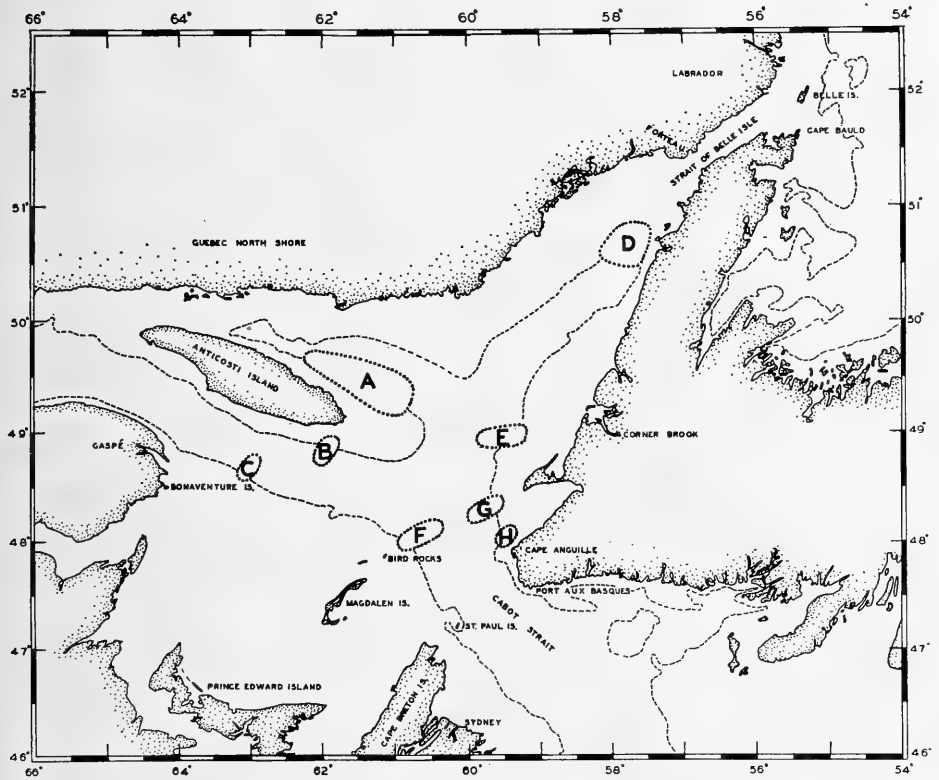


FIGURE 1. Areas in the Gulf of St. Lawrence where observations were made on birds associated with fishing operations.

Labrador Current enters the strait on the northern side, extending its influence into the gulf at least as far as Cape Whittle, while on the southern side the warmer and slightly less saline water from the Gulf of St. Lawrence flows out round Capes Norman and Bauld (Huntsman, Bailey and Hachey, 1954). The meeting of these two water masses, together with topographic and tidal effects, causes turbulence and vertical water movements with a consequent increase in marine productivity. The general temperature and current pattern of the Strait of Belle Isle is shown in Figure 2A and the approximate correlation of this pattern with bird numbers is shown in Figure 2B-D. The most marked correlation is shown in the distribution of the alcids (Thick-billed Murre, Puffin and Dovekie). These were moderately abundant in the Labrador Current water, were in greatest numbers where the two water masses meet and were practically absent from the gulf water. In 1960 Thick-billed Murres were encountered in large numbers along the northern side of the strait in the vicinity of Forteau Bay, but in 1961 the vessel kept to the southern side of the strait and comparatively few were seen west of Cape Norman. In connection with this temperature pattern it is of interest to note that all the largest alcid colonies of the

TABLE 1.—Estimates of the numbers of birds gathering as the trawl was brought up in various parts of the Gulf of St. Lawrence.

| Area | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| Days in area | 5 | 4 | 4 | 3 | 2 | 1 | 2 | 4 |
| Number of drags | 17 | 13 | 12 | 9 | 8 | 5 | 7 | 10 |
| Fulmar: | | | | | | | | |
| Average | 8 | 4 | 1 | 1 | 2 | 15 | 23 | 1 |
| Maximum | 20 | 15 | 1 | 5 | 3 | 15 | 25 | 5 |
| Great Black-backed Gull: | | | | | | | | |
| Average | 54 | 11 | 14 | 3 | 3 | 42 | 13 | 21 |
| Maximum | 200 | 70 | 50 | 10 | 20 | 50 | 30 | 40 |
| Herring type Gull: | | | | | | | | |
| Average | 53 | 14 | 35 | 15 | 4 | 76 | 13 | 40 |
| Maximum | 150 | 60 | 55 | 40 | 15 | 100 | 40 | 100 |
| Kittiwake: | | | | | | | | |
| Average | 55 | 32 | 15 | 8 | 80 | 48 | 24 | 40 |
| Maximum | 250 | 70 | 30 | 30 | 200 | 50 | 60 | 100 |

North Shore are on islands surrounded by waters strongly influenced by the Labrador Current and that no important colonies exist on the Newfoundland side of the straits. Shortage of suitable sites on the Newfoundland side also contributes to this.

The activity of the fishing fleets is another important factor which influences the distribution of the scavenging species of birds (Fulmar, Greater Shearwater and gulls). The statistics of the International Commission for the Northwest Atlantic Fisheries show that the main season for cod caught by otter trawlers in Division 3K (Belle Isle to Cape Freels) is during the months August to December. The principal fishery is by the large salting trawlers (averaging 1,200 gross tons) from France, Spain, Portugal and USSR and the region off Belle Isle and the Gray Islands is a particularly favoured fishing ground. The cod are beheaded, split and cleaned before salting and since most other species caught incidentally are discarded, there is a considerable supply of fish waste for the birds to feed on. By contrast the redfish fishery in the same area but farther offshore by USSR and German ships yields less bird food per ton of fish landed. Many of these are factory trawlers with fish meal plants which utilise a large part of their waste products. Even so there must still be a considerable supply of potential bird food washed out of the net as it comes to the surface and some must still be passed over the side in the washings from the factory. Indeed, it seems that flocks of several hundred birds gather round the British *Fairtry* factory trawlers even when practically all the waste is being consumed by the meal plant. These ships are comparable to the Russian BMRT stern fishing factory trawlers.

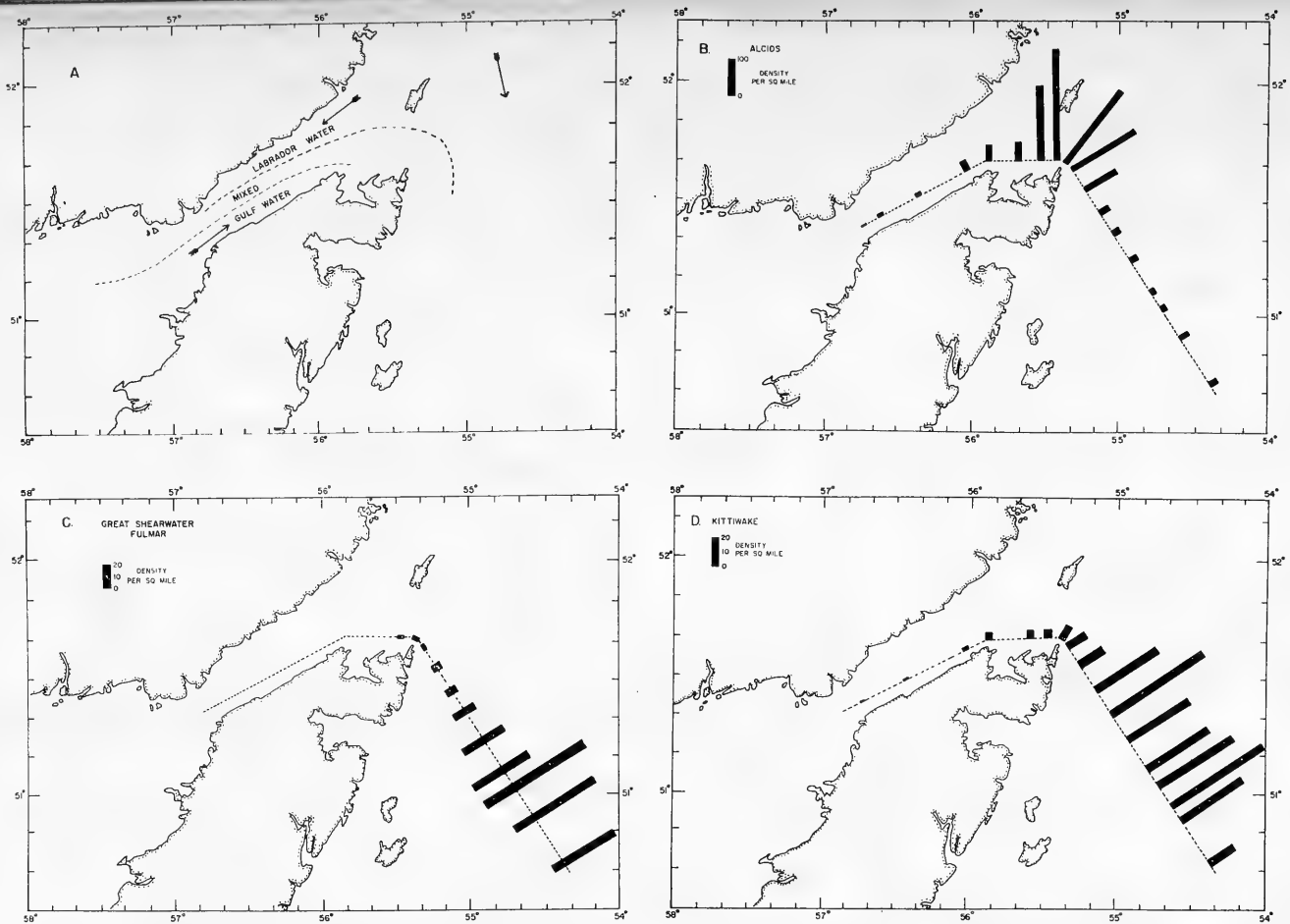


FIGURE 2. Belle Isle region showing: A. general oceanographic features; B-D. density distribution of birds along the route taken by the *A. T. Cameron* on November 11, 1961, B–alcids, C–Greater Shearwater (above right) and Fulmar (below left), and D–Kittiwake.

It is possible to derive some approximate figures of the numbers of birds which could be supported by fishing operations from the published statistics of the International Commission for the Northwest Atlantic Fisheries. In 1958, for example, the catch by the salting trawlers during October and November amounted to 8,066 metric tons or an average of 132.2 metric tons per day from Division 3K. The amount of waste available to the birds may reasonably be estimated at ten per cent of the weight caught. If each bird consumed one-half pound per day, then these ships could have provided food for nearly 60,000 birds. The estimate of waste, at ten per cent, is not unreasonably large, because the fish are split and cleaned and most species other than cod are usually discarded. The currently used conversion factor from gutted head off to round fresh is 1.6 for cod, so that, when the livers are allowed for, some thirty per cent by weight of each fish is discarded. Boswall (1960), describing bird feeding at a Scottish seine net vessel, gives figures that indicate that food available to the birds was equivalent to fifteen to twenty per cent of the landed catch, but the livers were being discarded from the seiner, while nearly all the salting trawlers are equipped to produce liver oil. The same methods applied to the redfish landings, using an estimate of waste at two per cent, gives figures indicating that food should have been available for an additional 60,000 birds. Altogether then, the two fishing fleets should theoretically have been able to support an additional three to four birds per square mile over the continental shelf part of the division, over and above that which could be maintained naturally.

It must be stressed that the estimates given above are of food which might be available and not of food that is actually consumed. This is because there is frequently a wide discrepancy between the amount of food available and the numbers of birds which gather to eat it. The more eager the birds are to get the food, the less time it has to sink and be lost. On many occasions I have seen birds at a trawler picking up choice pieces of food in a leisurely fashion and ignoring food items which they would fight for under less favourable circumstances. This state of affairs was frequently the case during the research vessel cruises to the Gulf of St. Lawrence. On this vessel the bulk of the catch is ultimately discarded after the detailed examinations have been made, so that the material available as bird food might amount to more than an estimated twenty-five per cent of the weight of the catch. Average catches for the thirty minute survey drags in this area were in the region of 800 pounds, so that theoretically enough extra food was available for approximately 400 birds per drag or 1,600 per day. In fact this is many times in excess of the numbers which were observed. There are several probable reasons why this source of food is not fully utilised and of these the most important is the erratic nature of the food supply.

Fishing fleets move widely in search of food and when a particular ship leaves the area the birds associated with it must disperse widely in search of natural foods, until they can attach themselves to another ship. The feeding economy of the scavenging bird population must then be based primarily on

the supply of natural foods and the birds which gather at a trawler must come from a wide area. By contrast, the populations of gulls, which are dependent upon urban refuse and sewage disposal systems, have a steady supply of food which they can utilise more fully. In addition, the number of ships fishing in the Northwest Atlantic has increased so rapidly during the last ten years, that it seems unlikely that the bird population could have become adjusted to it. On some of the fishing grounds on the European side of the Atlantic, where trawling has a much longer history and is carried out by a larger number of smaller fishing boats, it is possible that the available food supply is more fully utilised.

Commercial fishing in the offshore areas of the Gulf of St. Lawrence was negligible at the time I visited the area, so that the birds which gathered around the research vessel must have been an aggregation of a natural population. Unfortunately there is no satisfactory method of gauging the range from which the birds were attracted to the ship, so that the figures cannot be converted into an expression of density.

## ANNOTATED LIST OF SPECIES

*Fulmarus glacialis* FULMAR

Fulmars were seen in small numbers in all of the five fishing areas in the Gulf of St. Lawrence (Table I), but the numbers were insignificant when compared to the density at which they were seen in the area to the southeast of Belle Isle. This exceeded twenty-five per square mile, despite the absence of the attracting influence of fishing operations in the immediate vicinity. It has already been pointed out (Rees, 1961) that the Gulf of St. Lawrence should be included in the regular range of the Fulmar during the month of November in addition to those areas shown by Fisher (1951).

It can be seen from Table I that, in general, smaller numbers of Fulmars occurred in the areas farther from the Cabot Strait entrance to the gulf. In addition, it was noted that on neither of the passages down through the Strait of Belle Isle did any Fulmars follow the ship beyond Cape Norman. These two trends would seem to indicate that most of the Fulmars found in the gulf came into the area through the sixty mile wide Cabot Strait entrance. Random movements could bring them in through the wider southern entrance, but the narrower Strait of Belle Isle contains a fairly distinct oceanographic boundary, with the less productive water inside.

*Puffinus gravis* GREATER SHEARWATER

In most years the Greater Shearwaters depart from the Newfoundland Banks during October and only occasional stragglers are seen in this area in November and December (Wynne-Edwards, 1934; Rankin and Duffey, 1948; Peters and Burleigh, 1951). In the fall of 1961, however, they were seen commonly on the passage between St. John's and Belle Isle on November 10 and 11 and a few were still present at Banquereau on November 26. They certainly could not be described as stragglers since the density off the Gray Islands exceeded forty per square mile for several hours' steaming. None were seen when the same route was covered at the same season in 1960 and the ship's officers and men, all of whom are Newfoundlanders with a long established gastronomic interest in seabirds, also considered it unusual to see them so late in the year. A possible reason for the late departure may be the unusually

warm sea surface temperatures which prevailed during the fall of 1961. An illustration of this may be seen in the records from a hydrographic station in the Avalon Channel branch of the Labrador Current off Cape Spear which have been taken regularly throughout the year for a number of years. The surface temperature at this station was 8.8°C at the beginning of November and 6.0°C at the end of the month, whereas in most years the temperature drops below 5°C during the early part of the month.

These birds were presumably part of the large non-breeding population which this species seems to have, in common with the other members of the Procellariidae. The breeding birds gather at Tristan da Cunha in August and the eggs are laid in early November (Rowan, 1952). The non-breeders are known to range as far south as the Falkland Islands during the southern summer, although some remain north of the equator (Murphy, 1936).

All the shearwaters which came within range were checked for the possible presence of the North Atlantic or Cory's Shearwater *P. diomedea*, but none were seen. No shearwaters of any species were seen in the Gulf of St. Lawrence.

*Morus bassanus* GANNET

This species is common at sea in the Gulf of St. Lawrence during the summer months, especially in the vicinity of the famous breeding colonies at Bonaventure and Anticosti Islands (Brewster, 1883). In November, it was virtually absent from the areas visited during these fishery cruises and records were confined to a single bird seen off the north coast of Anticosti. The Gannet does, however, find most of its food in fairly shallow water and Godfrey (1958) mentions that A. W. Cameron reported to him that they were sometimes common off Port Hood, Cape Breton Island, in November.

*Catharacta skua* SKUA

A single bird followed the ship for a few minutes off Cape Norman in the Strait of Belle Isle on November 11, 1961, and another was seen off Cape Race on November 29. Both birds appeared very dark, probably due to the lack of barring on the body feathers. If so, they were probably young birds.

*Larus hyperboreus* GLAUCOUS GULL

Glaucous sized white gulls were seen throughout the region in small numbers, seldom exceeding one or two at any position. They occurred in the harbours and bays at Forteau, Corner Brook, Port aux Basques, Anticosti and Gaspe, as well as in the offshore area.

*Larus marinus* GREAT BLACKED-BACKED GULL

An omnipresent scavenger throughout the area concerned, both offshore and in the harbours. Waste from fishing operations is well suited to their dietary habits and the numbers which were attracted to the ship in the Gulf of St. Lawrence are shown in Table I. The usual relationship between gull numbers and the proximity of land was detectable even in this small enclosed sea.

*Larus argentatus* (sensu lato) HERRING TYPE GULLS

Rapid differentiation in the field between the three forms of *Larus* gulls (*L. a. smithsonians*, *L. glaucoides kumlieni*, and *L. g. glaucoides*) is difficult and in the case of young birds of the last two even museum skins cannot always be typed with certainty. Accordingly the various forms have been grouped together under one heading in Table I. By careful examination at close range using high-power binoculars I was able to pick out individuals with characters referable to each of the three forms.

The winter distribution of gulls in the Gulf of St. Lawrence is apparently another example of Gause's (1934) hypothesis that closely related species living

sympatrically do not have identical ecological habits. There was a marked difference in the relative numbers belonging to the various forms between the offshore fishing areas and the coasts and harbours. The more migratory *glaucoides* forms made up about eighty-five per cent of the gulls which gathered during the offshore fishing operations, but in the bays and harbours the semi-resident form *smithsonianus* was generally in the higher proportion. In addition to this difference in offshore and inshore distribution there was also a difference between the northern and southern parts of the area. North of a line from Anticosti to Cape St. George the Iceland gulls were slightly more abundant than they were in the southern part of the area. This was particularly noticeable at the various harbours. At Forteau about sixty-five per cent were Iceland gulls, but in the south, at Sydney, they made up only a small proportion of the gulls seen. Godfrey (1958) in his "Birds of Cape Breton Island" does not mention either of the Iceland gulls, but at Sydney on November 23, 1961 there were at least six Iceland Gulls. Close examination showed that two of these were of the *glaucoides* form and the other four belonged to the *kumlieni* form. It was this form which probably made up the bulk of the gulls seen offshore, which is borne out by Macpherson's (1961) contention that the Gulf of St. Lawrence is part of the main wintering area for *kumlieni*. It is to be hoped that someone will have an opportunity to make a collection from this area during the winter months.

*Rissa tridactyla* KITTIWAKE

This was the most abundant species in the open waters of the Gulf of St. Lawrence (Table I) and it was also very abundant off Belle Isle, where densities exceeding fifty per square mile were recorded. A remarkably high percentage (eighty per cent) of the Kittiwakes off Belle Isle were young birds in the first winter plumage. This is of interest in view of the fact that a significant number of young Kittiwakes banded in Greenland and Europe have been recovered off the northeast coast of Newfoundland during the first two years of their lives (Peters and Burleigh, 1951; British Birds Ringing Supplements 1950-1960; L. M. Tuck, personal communication).

Kittiwakes are primarily plankton feeders, but they also scavenge around fishing boats when the opportunity occurs. Kittiwakes were frequently observed taking the food which had been ejected from fish stomachs and which washed out of the net as it came to the surface. Redfish, which were the principal species being caught, suffer from the effects of decompression as they are brought to the surface and they are frequently found to have their stomachs blown out through their mouths. The redfish food in this area consisted mainly of the euphausiids – *Meganyctiphanes norvegica*, *Thysanoessa inermis* and *T. raschii*, with smaller quantities of the hyperiid amphipod – *Parathemisto abyssorum*, the mysid *Boreomysis tridens* and the copepods *Pareuchaeta norvegiica* and *Calanus hyperboreus*. All these species belong to groups which form the natural food of Kittiwakes. This same habit of feeding upon extruded fish stomach contents was noted by Bagenal (1951) for Wilson's Petrels, *Oceanites oceanicus*, at a factory trawler on the Grand Banks during the summer months. In addition to the previously mentioned invertebrates the Kittiwakes were also seen to pick up the smallest of the redfish which were washed out of the net at the surface. On the basis of the catch measurements, these were probably 6-8 cm in length.

*Uria lomvia* THICK-BILLED MURRE

The density distribution of alcids off the Strait of Belle Isle has already been discussed and illustrated (Figure 2B) in relation to the prevailing oceanographic conditions. It was this species that made up the largest part of this alcid concentration (over eighty-five per cent). All

the murres which were seen at a range close enough for satisfactory identification belonged to this species, as did twenty-six birds which I examined in the hand at Forteau on November 9, 1960. Off the Strait of Belle Isle the density pattern agreed fairly well with that found by Tuck (1961), but in the Gulf of St. Lawrence far less were seen than the ten to one hundred per square mile envisaged by him (Tuck, 1961, fig. 12, p. 96). On neither of the two cruises were more than occasional scattered birds seen in the Gulf and densities were apparently less than one per square mile at this season.

*Plautus alle* DOVEKIE

This species occurred fairly abundantly off the Strait of Belle Isle, with densities of twenty to thirty per square mile being found over a wide area in 1961. In 1960 I passed through the same area without noticing any, but this was probably due to unfavourable weather conditions. During these cruises occasional birds were noticed in the strait but none were seen in the gulf. This species occurs commonly in the gulf later in the winter and several records from a research vessel cruise in January 1962 were supplied to me by Capt. B. G. Blackwood and the officers of the *A. T. Cameron*. Dr. W. Templeman has told me that during the same cruise a Dovekie was found in the stomach of a cod which had been caught at a depth of sixty fathoms.

*Cepphus grylle* BLACK GUILLEMOT

The only record from these cruises is of a single bird at Forteau Bay. This species is seldom found at any distance from the land.

*Fratercula arctica* PUFFIN

A few Puffins occurred amongst the Belle Isle alcid concentration, but never at densities higher than five per square mile. None were noticed in the Gulf of St. Lawrence.

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# A CONTRIBUTION TO THE KNOWLEDGE OF THE FLORA OF SOUTHWESTERN MACKENZIE DISTRICT N.W.T.*

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During the summer of 1961 the author returned to Mackenzie District to study the vegetation and to make plant collections. Mr. K. W. Spicer acted as assistant. The period July 15 to August 12 was spent along the Liard River between the British Columbia border and the South Nahanni River, in conjunction with a soil survey party. Prior to the Liard survey, studies were conducted in the Fort Simpson area (61°52′N, 121°22′W) at the junction of the Liard and Mackenzie Rivers, and briefly as far upstream on the Mackenzie River as Browning's Farm near Trout River (61°17′N, 119°47′W). This work along the Mackenzie supplemented studies carried out here in 1955 which have since been reported in this Journal (Cody, 1961). In addition in mid-August short visits were made to Cli Lake (61°58′N, 123°25′W) and Little Doctor Lake (61°52′N, 123°20′W) which lie adjacent to the Nahanni Range, the easternmost range of the Mackenzie Mountains, some seventy miles northwest of Fort Simpson. Numerous collections were made. These are preserved in the Herbarium of the Canada Department of Agriculture at Ottawa (DAO). Those records of particular interest are reported here. The collection numbers cited throughout the text are those of the author unless otherwise stated.

Raup (1947) brought together our knowledge of the flora of Southwestern Mackenzie District. Since that time Cody, Thieret and Jeffrey have added to the botanical knowledge of this region. Prior to our visit, the only plant collections made on the Liard were a few specimens of Nowosad and Crickmay (Raup, 1947) and the more extensive collections of Jeffrey (Jeffrey, 1961). That the flora is still not completely known is amply demonstrated by the many species treated in the present paper. Further collecting will undoubtedly produce more additions to the flora.

### Ophioglossaceae

*Botrychium virginianum* (L.) Sw. var. *europaeum* Angstr. In moist moss in clearing in *Picea glauca* woods, lower slopes of Mount Flett 32 miles north of Fort Liard, *11860*.

Previously known in Mackenzie District from a single collection by Wynne-Edwards from Lone Mountain (Raup, 1947; Porsild, 1945).

### Polypodiaceae

*Matteuccia struthiopteris* (L.) Todaro var. *pensylvanica* (Willd.) Morton, *Pteretis nodulosa* (Michx.) Nieuwl. Alluvial terrace of island in Liard 16 miles southwest of Fort Liard, *11578;* rare in partial shade on slipping creek bank just below Big Island on Liard River, 60°31′N, 123°30′W, *11821;* occasional, moist river terrace under *Populus*, *Picea* and *Betula*, Liard River 1 mile above Blue Bill

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Creek 42 miles north of Fort Liard, *11954;* on river terrace in partial shade of *Picea glauca, Populus balsamifera, Alnus tenuifolia, Cornus* and *Salix*, Liard River ½ mile upstream from Netla River, 8 miles south of Nahanni Butte, *11984.*

Raup (1934) records *Pteretis nodulosa* from Peace River near mouth of Wicked River and near Lesser Slave Lake; Porsild (1951) states "The species has not yet been collected in Yukon but is common at Liard Hot Springs, B.C., just outside the southeast boundary . . ."; Jeffrey (1961) recorded this species *sub P. nodulosa* as new to Mackenzie District on the basis of specimens presumably collected near Fort Liard: our collections show that it is distributed along the floodplains of the Liard River downstream to nearly its junction with the South Nahanni River.

*Gymnocarpium robertianum* (Hoffm.) Newm., *Dryopteris robertiana* (Hoffm.) C. Chr., *Thelypteris robertiana* (Hoffm.) Sl. In partial shade on slipping creek bank just below Big Island on Liard River, 60°31′N, 123°30′W.

Previously known in Mackenzie District from three localities: Lone Mountain (Porsild, 1945; Raup, 1947), Willow Lake River (Raup, 1947) and Enterprise—Mackenzie River Highway (Thieret, 1961 *sub G. dryopteris*).

*Gymnocarpium dryopteris* (L.) Newm. *Dryopteris disjuncta* (Ledeb.) Morton, *D. linnaeana* C. Chr., *Thelypteris dryopteris* (L.) Sl., *Polypodium dryopteris* L.

In moss on wooded slope, west side of Liard River 18 miles southwest of Fort Liard, *11567.*

The only other record for Mackenzie District other than Hooker (1825-40) ". . . to Bear Lake" is that of Raup (1947) from Brintnell Lake. *Thieret, 5156* from Enterprise —Mackenzie River Highway (Thieret, 1961) is *G. robertianum.*

*Asplenium viride* Huds. Rare in shallow soil in moist crevice by creek, middle slope of Nahanni Range west end of Little Doctor Lake, 61°52′N, 123°20′W, *12166.*

Rare in Mackenzie District; previously known from only one collection: Lone Mt. (Raup, 1947; Porsild, 1945) at the northern end of the Nahanni Range.

*Pellaea glabella* Mett. ex Kuhn var. ***nana*** (Richardson) Cody comb. nov., *Pteris gracilis* var.? *nana* Richardson Bot. Appendix to J. Franklin, Narrative of a Journey to the shores of the Polar Sea in the years 1819, 20, 21 and 22: 750. 1823, *Pellaea glabella* var. *occidentalis* (E. Nelson) Butters Am. Fern Jour. 7:82, 1917, *Pellaea atropurpurea* var. *occidentalis* E. Nelson Fern. Bull. 7:30. 1899, *Pellaea pumila* Rydb., *Pellaea occidentalis* (E. Nelson) Rydb. Rare in crevices on steep rock face, lower slope of Nahanni Range at west end of Cli Lake, 61°52′N, 123°20′W, *12242.*

This is the second record for Mackenzie District. The only other specimen from there was collected from west ridge of Franklin Mts. at River-Between-Two-Mts. (*Crickmay, 9* (CAN)) and was cited by Raup (1947) as *P. glabella.*

The type of var. *nana* was collected by Richardson at Clearwater River [Sask] (BM ! photo DAO). A specimen labelled Clearwater River N.W.T. (*Jas. M. Macoun s.n.*, July 11, 1887 (CAN)) was cited by John Macoun (1888) "on limestone cliffs, Clearwater River, north of Methy Portage, Lat. 57°, N.W. Ter." *sub Pellaea atropurpurea.* It was undoubtedly collected at the same place as the type, since Methy Portage was a regular stopping place of the voyageurs.

*Polypodium virginianum* L. Rare in moss in crevice in small face near summit of Mount Coty, 60°18′N, 123°30′W, *11800.*

Scattered in the Pre-Cambrian region of Mackenzie District as far north as Great Bear Lake (Cody, 1956) but apparently previously unknown from the Paleozoic region. The nearest sites to the west and south are in western Yukon Territory, *J. B. Tarleton, 154* (DAO) and Mt. Selwyn in Northern British Columbia (Raup, 1934).

### LYCOPODIACEAE

*Lycopodium annotinum* L. var. *annotinum* Moist *Populus tremuloides* woods on upper slopes of Mount Coty opposite Fort Liard, *11782;* in moss among *Alnus* and *Betula*, west end of Cli Lake, *12325.*

Recorded by Raup (1936) as occurring northward to Great Bear Lake but no mention is made of this variety in his Botany of Southwestern Mackenzie (Raup, 1947); Jeffrey (1961) however recorded it from the Liard Range of which Mount Coty forms a part.

PINACEAE

*Pinus banksiana* Lamb. Trees to 12 ft. in height among *Salix* and *Populus tremuloides*, Nahanni Butte, 61°03′N, 123°23′W, *12033A;* trees to 10 ft. high, dbh 1½ inches, lower slopes of Nahanni Range, west end of Cli Lake, 61°58′N, 123°25′W, *12223;* young trees 3 to 10 ft. in height, scattered in *Sphagnum* meadow with *Picea mariana, Larix laricina, Betula glandulosa, Ledum groenlandicum, Andromeda polifolia* and *Chamaedaphne calyculata*, Liard River 7 miles below Blue Bill Creek, 44 miles north of Fort Liard, *11982A.*

Jeffrey (1961) cites a specimen collected on Nahanni Butte and mentions the occurrence of this species at six unspecified stations in the area of his survey.

*Pinus contorta* Dougl. var. *latifolia* Engelm. Trees to 30 ft in height and dbh 5 inches, very common on upper third of Mount Coty with *Picea glauca* and some *Betula papyrifera, Populus tremuloides* and *P. balsamifera, 11808.*

*Pinus contorta* was recorded from Mackenzie District by Flook (1959) based on a collection from "61°12′N, 124°25′W on the plateau just south of the South Nahanni River at an elevation of about 2800 feet..." I have not seen the specimen. Our specimens have the typical asymmetrical reflexed cones which have scales with very thick umbos and firm spines. Jeffrey (1961) cites several collections from the Liard Range of which Mount Coty forms a part.

x *Pinus murraybanksiana* Righter & Stockwell, *P. contorta* var. *latifolia* x *P. banksiana* Trees to 12 ft. in height among *Salix* and *Populus tremuloides*, Nahanni Butte, 61°03′N, 123°23′W, *12033B;* trees 8 to 10 ft. high, dbh 1½ inches, lower slopes of Nahanni Range, west end of Cli Lake, 61°58′N, 123°25′W, *12224;* young trees 3 to 10 ft. in height, scattered in *Sphagnum* meadow with *Picea mariana, Larix laricina, Betula glandulosa, Ledum groenlandicum, Andromeda polifolia* and *Chamaedaphne calyculata*, Liard River 7 miles below Blue Bill Creek, 44 miles north of Fort Liard, *11982C;* Rabbitskin River (E. of Fort Simpson) 120°00′W, *Frank Bailey, s.n.*, 1960 (DAO).

This hybrid has not previously been recorded from Mackenzie District; in all cases except the last listed collection it was found growing with only one parent species, *P. banksiana*, although *P. contorta* var. *latifdia* is known from the region (Jeffrey 1961, Flook, 1959).

*Juniperus horizontalis* Moench One large shrub covering about 15 sq. ft. on steep eroding clay bank of north shore of Mackenzie River about 5 miles below Cache Island, 61°25′N, 120°10′W, *11418;* rare on steep open slope overlooking lake, Little Doctor Lake, *12100;* prostrate in very shallow soil on steep slope of Nahanni Range, west end of Cli Lake, *12225.*

Apparently rare in Mackenzie District north of Great Slave Lake; Raup (1947) recorded it from Wrigley and Nahanni Mt. and Cody (1960) recorded it from west of Norman Wells. I have also seen a specimen from Fort Good Hope on the Mackenzie River (private herbarium of C. Goutier). Jeffrey (1961) recorded this species from Nahanni Butte from whence I have also collected it (*12032*).

SCHEUCHZERIACEAE

*Triglochin maritimum* L. Common on moist shore of lake, Little Doctor Lake, *12064.*

Our collection helps fill the gap in the known distribution of this species between Fort Providence (Thieret, 1961) and Norman Wells (Cody, 1960).

*Triglochin palustre* L. Moist outwash of creek, middle slope of Mount Flett, 32 miles north of Fort Liard, *11895;* in sod in partial shade at back of beach, Little Doctor Lake, *12109.*

In southwestern Mackenzie District, not previously recorded from west of Fort Simpson.

GRAMINEAE

*Bromus ciliatus* L. Rare among open *Populus balsamifera* and *Equisetum hyemale* in silty soil, island in Liard River 15 miles southwest of Fort Liard, *11508;* steep eroding bank of Petitot River near its mouth on Liard River, Fort Liard, *11720.*

Apparently rare in Mackenzie District; previously recorded only from Fort Resolution and Fort Norman (Raup, 1947).

*Bromus inermis* Leyss One clump at back of garden, Fort Liard, *11763*.

Introduced; previously recorded from Hay River (Cody, 1956), Fort Providence and Fort Simpson (Cody, 1961). I also have a specimen from Fort Smith (*3938*). It will probably eventually be found in most of the larger townsites in southern Mackenzie District.

*Glyceria striata* (Lam.) Hitchc. var. *stricta* (Scribn.) Fern. Rare in wet silt of creek bed in *Picea glauca, Populus balsamifera* woods, west side of Liard River 18 miles southwest of Fort Liard, *11570;* rare in moist creek-bed, just below Big Island on Liard River, 20 miles north of Fort Liard, *11828*.

Raup (1936) stated that this plant was unknown to him north of the Athabaska region, but Hultén (1941-52) gave the range "Yukon and Alaska over the Great Slave Lake Region . . .". The Great Slave Lake distribution may have been a misinterpretation based on the title of Raup's paper "Phytogeographic studies in the Athabaska—Great Slave Lake region". Porsild (1951) stated that *G. striata* had thus far not been collected in the Yukon although it had been collected in central Alaska and at the Liard Hot Springs in northern British Columbia. I have not seen any other collections from Mackenzie District but Jeffrey (1961) recorded it as new to Mackenzie District on the basis of a collection from the Mackenzie Lowlands, probably south of Fort Liard.

*Phragmites communis* Trin. var. *berlandieri* (Fourn.) Fern. Yohin (Jackfish) Lake, 61°12′N, 123°46′W, 18 miles NW of Nahanni Butte, *G. Kraus s.n.*, Fall 1961 (DAO).

In August 1961 Mr. Kraus reported the occurrence of a tall grass which grew in a dense stand at Yohin Lake. This species was not known to him elsewhere in the region. He kindly collected specimens when he revisited the area in the fall and forwarded them for identification. The nearest known locality is at the western end of Lake Athabaska (Raup, 1936) some 450 miles to the southeast. *P. commis* var. *berlandieri* does not reproduce by seed in southern Canada, but these specimens appeared to have set some good seed. New to the flora of Mackenzie District.

*Agropyron trachycaulum* (Link) Malte var. *glaucum* (Pease & Moore) Malte Cabin clearing, west side of Liard River 18 miles southwest of Fort Liard, *11603;* gravelly bank of Petitot River ½ mile upstream from Liard River, Fort Liard, *11731;* rare in shallow soil among stones on steep slope, Nahanni Butte, *12054*.

Previously recorded for Mackenzie District from around Great Slave Lake (Cody, 1956) and Canol Road (Cody, 1960) but not from the Liard River area.

*Agropyron angustiglume* Nevski Scattered on steep open slope overlooking lake, Nahanni Range, Little Doctor Lake, 61°62′N, 123°20′W, *12099*.

Our specimen keyed out to this taxon in Hultén's key quite readily. *A. angustiglume* has not previously been recorded for Mackenzie District.

*Agropyron sericeum* Hitchc. Rare on Liard River bank in front of settlement Fort Liard, *11680*.

Previously recorded for Mackenzie District from Norman Wells (Cody, 1960) and Fort Simpson (Cody, 1961).

*Agropyron alaskanum* Scribn. & Merr. var. *alaskanum* A few clumps in cabin clearing, Nahanni Butte settlement, *12022;* shallow soil on rocky hillside, Indin Lake, 64°17′N, 115°12′W, *3417;* moist soil on hillside over igneous rock, Port Radium, east end of Great Bear Lake, *2801*.

The nodes of these three specimens are all finely appressed pilose and thus key out readily to *A. alaskanum*. There is however considerable variation in length of the awns, particularly in No. *12022*.

Var. *alaskanum* has not previously been recorded from Mackenzie District. Var. *arcticum* Hultén, which Hultén recorded as occurring at Bathurst Inlet and Cape Bathurst on the arctic coast is represented in our herbarium by one collection: south end of Darnley Bay east of mouth of Hornaday River, *Ross Mackay* s.n. 1951.

X *Agrohordeum macounii* (Vasey) Lepage, *Elymus macounii* Vasey, *Agropyron trachycaulum* X *Hordeum jubatum*. Occasional clump in cabin clearing, west shore of Liard River 8 miles southwest of Fort Liard, *11653;* in sod at top of Liard River bank,

Fort Liard, *11703;* a few clumps in cabin clearing, Liard River at mouth of Netla River 8 miles south of Nahanni Butte, *12001.*

Previously known in Mackenzie District from Salt Plain west of Fort Smith northward along the Mackenzie River to Norman Wells (Cody, 1956, 1960, 1961) but not along the Liard River. It was noted only in disturbed situations.

*Elymus sibiricus* L., *E. canadensis sensu* Jeffrey (1961). Rare in cabin clearing west shore of Liard River 8 miles southwest of Fort Liard, *11658;* rare in waste ground of settlement, Fort Liard, *11713;* in loose soil below cut bank of river, mouth of small creek just below Big Island on Liard River, 60°31'N, 123°30'W, *11813;* on cut bank of Liard River, 1 mile above Blue Bill Creek, 42 miles north of Fort Liard, *11953;* rare on cut and slipping bank of river, Liard River ½ mile below Blue Bill Creek 44 miles north of Fort Liard, *11955;* top of cut bank of Liard River east bank 3 miles south of Nahanni River, *12004;* rare in cabin clearing, Liard River at mouth of Netla River, 8 miles south of Nahanni Butte, *12002;* a few scattered clumps in cabin clearing, settlement of Nahanni Butte, two miles up Nahanni River from Liard River, *11490, 12024;* Kotaneelee River, *Jeffrey, 119* (CAN).

When the occurrence of *Elymus sibiricus* in Mackenzie District (Bowden and Cody, 1961; Cody, 1961) from Fort Simpson and Liard River at mouth of Nahanni River was reported, it was intimated that this species might possibly be introduced. First observations during the summer of 1961 seemed to bear this out, but subsequently it was found in situations where it could only occur naturally. In Mackenzie District *E. sibiricus* is found occasionally in disturbed situations along the Liard River from near the British Columbia border to Fort Simpson at the top of the cut banks and on the steep eroding slopes. From these situations it has appparently spread to settlements and cabin clearings where it often forms clumps as large as 18 inches in diameter. *E. sibiricus* should be looked for in similar situations both in northern British Columbia and the Yukon Territory.

*Elymus canadensis* L. Steep eroding bank of Petitot River near its mouth on Liard River, Fort Liard, *11718.*

Previously known in Mackenzie District from only two collections on Great Slave Lake (Cody, 1956); the specimen, *Jeffrey 119* from the Kotaneelee River cited by Jeffrey (1961) as *E. canadensis* is *E. sibiricus.*

*Hordeum jubatum* L. Common on Liard River bank in front of settlement, Fort Liard, *11673;* cabin clearing, west side of Liard River 18 miles southwest of Fort Liard, *11600;* occasional clump in cabin clearing, west shore of Liard River, 8 miles southwest of Fort Liard, *11654;* common in cabin clearing, Liard River at mouth of Netla River, 8 miles south of Nahanni Butte, *11991.*

Previously known along the Liard River only at Fort Simpson (Raup, 1947) where I have also collected it; found only in disturbed situations.

*Sphenopholis intermedia* (Rydb.) Rydb. Rare, gravelly bank of Petitot River ½ mile upstream from Liard River, Fort Liard, *11738.*

Previously recorded for Mackenzie District from Alexandra Falls, Hay River (Cody, 1956) and near Fort Simpson (Cody, 1961). Thieret has also collected it at Hay River and along the Enterprise–Mackenzie Highway (DAO).

*Cinna latifolia* (Trev.) Griseb. A few small clumps, steep eroding alluvial bank of river, west side of Liard River 18 miles southwest of Fort Liard, *11526;* rare on shaded trail by Petitot River ½ mile upstream from the Liard River, Fort Liard, *11748;* in wet moss in *Picea glauca, Betula papyrifera, Alnus* woods, at upper end of Big Island, Liard River 15 miles north of Fort Liard, *11838;* a few plants among *Equisetum arvense* on steep moist sandy river bank, Liard River, 1 mile above Blue Bill Creek 42 miles north of Fort Liard, *11940;* small clump in moist ground among *Equisetum arvense* in clearing by river, Nahanni Butte Settlement, *12023.*

Jeffrey (1961) cited three specimens from his survey area, but without definite localities; until these collections were made, this species was known in Mackenzie District only from Fort Simpson (Raup, 1947), where I have also collected it.

*Phleum pratense* L. Rare in cabin clearing, Nahanni Butte Settlement, *12005.*

Introduced; not previously recorded from along the Liard River except at Fort Simpson (Cody, 1961) but certainly to be expected in the settlements.

*Muhlenbergia glomerata* (Willd.) Trin. var. *cinnoides* (Link) F. J. Herm. Bank of river among other grasses, forbs and shrubs, Petitot River ½ mile upstream from Liard River, Fort Liard, *11751;* in shallow soil among stones on steep slope, Nahanni Butte, 61°03′N, 123°23′W, *12045.*

Thieret (1961) recorded this entity as new to Mackenzie District on the basis of several collections from along the Enterprise–Mackenzie River Highway. Our collections extend the known distribution in the District westward some 200 miles.

*Stipa viridula* Trin. Scattered clumps in cabin clearing, Rabbitskin River at Mackenzie River, 61°47′N, 120°42′W, *11449.*

This is a range extension of some 375 miles northward from Dunvegan in the Peace River District of northern Alberta (Raup, 1934); new to Mackenzie District.

*Hierochloe odorata* (L.) Beauv. Wet alluvial soil of terrace overlooking river, west shore of Liard River 8 miles southwest of Fort Liard, *11633.*

Not previously recorded from west of Fort Simpson in southwestern Mackenzie District.

### CYPERACEAE

*Eriophorum russeolum* Fries var. *albidum* Nyl., *E. chamissonis* C. A. Mey. forma *albidum* (Nyl.) Fern. In *Sphagnum* in open black spruce muskeg, west shore of Liard River 14 miles southwest of Fort Liard, *11612.*

Apparently rare; previously recorded for Mackenzie District from Great Slave Lake (Raup, 1947) Norman Wells (Cody, 1960) and Fort Simpson (Cody, 1961).

*Scirpus microcarpus* Presl Rare, west side of Liard River 18 miles southwest of Fort Liard, *11571;* east side of Liard River 15 miles southwest of Fort Liard, *11598;* in silt in seepage area on river bank, Liard River 1 mile above Blue Bill Creek, 42 miles north of Fort Liard, *11949.*

Previously recorded for Mackenzie District from only two localities: Resolution (Raup, 1947) and Fort Simpson (Cody, 1961).

*Carex eleocharis* Bailey Forming dense mat on dry hillside overlooking Mackenzie River at Rabbitskin River, 60°47′N, 120° 42′W, *11450.*

Hultén (1941-52) gives the range of *C. stenophylla* ssp. *eleocharis* as "probably isolated in Yukon, then from the Great Slave Lake distr. to Manitoba and N.W. Iowa. . ." The Great Slave Lake distr. no doubt refers to the record from the Athabaska–Peace Delta, Alberta, in Raup's (1936) Phytogeographic Studies in the Athabaska–Great Slave Lake Region. New to the flora of Mackenzie District.

*Carex chordorrhiza* Ehrh. Rooted in *Sphagnum* in sedge meadow, Liard River 7 miles below Blue Bill Creek, 44 miles north of Fort Liard, *11976.*

Although known both to the north of latitude 65° (Porsild, 1943; Cody, 1960) and to the south in northern Alberta (Raup, 1936; Cody, 1956), this species has not previously been recorded from southern Mackenzie District.

*Carex tenuiflora* Wahl. In open black spruce muskeg, west shore of Liard River 14 miles southwest of Fort Liard, *11610.*

Not previously recorded for southwestern Mackenzie District, but known at Norman Wells (Cody, 1960) and Great Slave Lake (Raup, 1936).

*Carex brunnescens* (Pers.) Poir In clumps among *Betula glandulosa* and *Ledum groenlandicum* under *Pinus* and *Picea* just below summit of Mount Coty, *11805;* 1 year old burn, Beniah Lake, 3 miles SE of south tip, 63°25′N, 112°20′W, *G. W. Scotter, 1204* (DAO).

New to the flora of Mackenzie District; a range extension northward from Lake Athabaska (Raup, 1936).

*Carex deweyana* Schw. Clump among *Calamagrostis* in clearing among *Salix, Alnus, Betula* and *Populus,* Liard River 2 miles above Blue Bill Creek, 42 miles north of Fort Liard, *11934.*

Jeffrey (1961) cites specimens from Fort Liard, Liard Range and floodplains of the Liard River; the species is not otherwise recorded from north of McMurray (Raup, 1936) in Alberta, and the Peace River District (Raup, 1934) of northern Alberta and British Columbia some 300 miles to the south.

*Carex filifolia Nutt.* Rare in shallow soil over stones on steep slope, Nahanni Butte, *12059.*

Until this collection known in Mackenzie District from only one locality, Wrigley (Porsild, 1951). Porsild has also recorded this plant in the Yukon from Whitehorse and along the Canol Road.

*Carex rossii* Boott, *C.* ? *tonsa sensu* Cody (1961), ? *C. umbellata pro parte sensu* Boott in Hooker (1829-40), Richardson in Arct. Search. Exped. 2: 344. 1851. London. In clumps in dry sand of roadside at edge of *Populus tremuloides, Pinus banksiana* woods on mainland one mile south of Fort Simpson, *11475.*

This ample collection is from the exact locality from which I collected No. *9092,* the basis for my report of *C.* ? *tonsa.* Richardson reported *C. umbellata* from Fort Simpson. Raup (1947) referred this report to *C. tonsa* but this species is not otherwise known from north of Lake Athabaska. *C. rossii* has previously only been recorded in Mackenzie District from Fort Smith, Yellowknife and Snare River (Cody, 1956) but Thieret has also collected it several times along the Enterprise–Mackenzie River Highway.

It is interesting to note that *C. umbellata* was omitted by the typesetter on p. 463 in the 1852 New York edition of Richardson's Arctic Searching Expedition. This, together with several errors noted in spelling would indicate that extreme caution should be used when consulting the 1852 edition.

*Carex glacialis* Mack. Common on rocky foothills, Nahanni Range at west end of Little Doctor Lake, *12122.*

An arctic-alpine species; apparently rare in southwestern Mackenzie District.

*Carex eburnea* Boott Rare in partial shade in shallow soil over gravel of creek bank, lower slopes of Mount Flett, 32 miles north of Fort Liard, *11871;* openly wooded slope by lake, Little Doctor Lake, *12085;* gravel at back of beach, west end of Cli Lake, *12280.*

Previously recorded from central Mackenzie District (Raup, 1947; Porsild, 1945; Cody, 1960), but apparently not previously recorded from soutwestern Mackenzie District. Thieret has however also collected it along the Enterprise–Mackenzie River Highway.

*Carex aurea* Nutt. Rare, moist ground by creek, middle slope of Mount Flett, 32 miles north of Fort Liard, *11888.*

Although recorded from Fort Simpson (Raup, 1947) where I have also collected it, not otherwise known along that part of the Liard River in Mackenzie District.

*Carex vaginata* Tausch. In deep moss among *Picea, Ledum groenlandicum* etc., lower slopes of Mount Flett, 32 miles north of Fort Liard, *11879;* among *Betula glandulosa,* west end of Cli Lake, 61°58′N, 123° 25′W, *12315.*

Jeffrey (1961) cited a single collection from a black spruce forest habitat in the Mackenzie Lowlands; it is otherwise unrecorded from along that part of the Liard River which lies in Mackenzie District, but I have a specimen collected at Fort Simpson at the junction of the Liard and Mackenzie Rivers in 1955 (*9145*).

*Carex viridula* Michx., *C. oederi* Retz. var. *viridula,* (Michx.) Kuk., *C. oederi* var. *pumila sensu* Fern. In wet sod among stones along beach, Little Doctor Lake, *12186.*

Although known from Great Bear Lake (Porsild, 1943) and Great Slave Lake (Raup, 1936) where I have also collected it, this species has not previously been recorded for southwestern Mackenzie District.

*Carex paupercula* Michx. (inc. var. *irrigua* (Wahl.) Fern.) Rare in open black spruce muskeg, west shore of Liard River 14 miles southwest of Fort Liard, *11619.*

Apparently rare in southwestern Mackenzie District; previously recorded only from Fort Simpson (Cody, 1961), Norman Wells (Cody, 1960), Mackenzie Mts. (Porsild, 1961) and Great Slave Lake (Raup, 1936) in the region.

*Carex* ? *albo-nigra* Mack. Rare in shallow soil over rock in windblown clearing on summit of Mount Coty, 60°18′N, 123°30′W, *11792.*

This collection seems best referred here, at least for the present; *C. albo-nigra* has been previously recorded only once from Mackenzie District: Red Mt. (Raup, 1947).

JUNCACEAE

*Juncus nodosus* L. Moist gravel at back of beach, Little Doctor Lake, *12111*.

Hooker (1829-40) noted this species "Canada to Bear Lake" but the northernmost collection with exact locality data cited by Raup (1947) was from Fort Simpson, where I have also collected it. Previous collections have all been adjacent to the Mackenzie River; the present collection is from near the base of the Nahanni Range, well back from the Mackenzie River shore.

LILIACEAE

*Allium schoenoprasum* L. var. *sibiricum* (L.) Hartm. Wet clay banks of river, Fort Liard, *11722*.

Previously recorded for the Liard River in Mackenzie District from a single collection by Crickmay "between Nahanni Butte and Simpson" (Raup, 1947).

*Smilacina stellata* (L.) Desf. In shallow soil among stones on steep slope, Nahanni Butte, *12052*.

This is the first record for this species from the Liard River in southwestern Mackenzie District, but previously known in the region from along the Mackenzie River and around Great Slave Lake (Cody, 1961) and at Red Mt. north of Brintnell Lake (Raup, 1947).

IRIDACEAE

*Sisyrinchium montanum* Greene, S. *angustifolium sensu* Raup (1947) and Porsild (1945) Steep open bank of creek, lower slopes of Mount Flett, 32 miles north of Fort Liard, *11876*.

The only other record for this species from the Liard River in Mackenzie District is the rather vague locality of Crickmay cited by Raup "between Nahanni Butte and Simpson".

ORCHIDACEAE

*Cypripedium calceolus* L. var. *parviflorum* (Sal.) Fern., *C. parviflorum* Sal. Open gravelly slope, middle slope of Mount Flett, 32 miles north of Fort Liard, *11904*.

Apparently a rare species in southwestern Mackenzie District; Raup (1947) records only three collections: Liard R. between Nahanni Butte and Simpson, Bear Rock and Nahanni Mt. I also have collections from the Nahanni Range at Cli Lake and Little Doctor Lake, just south of Nahanni Mt.

*Malaxis paludosa* (L.) Sw. Rare, only one plant found in *Sphagnum* of open black spruce muskeg, west shore of Liard River 14 miles southwest of Fort Liard, *11623*.

Baldwin (1961) has reviewed the previously known distribution of this rare species in North America. He cites specimens from Alaska, British Columbia and Ontario, and reports its occurrence from Minnesota and Alberta on the basis of literature records. The only record for Alberta is that of Moss (1959), who states that it is rare, but does not cite specimens or localities. A collection, *George Pegg, 719* (DAO), 11 Aug. 1959 from Glenevis, Alta. which was received recently substantiates the Moss record. *M. paludosa* is new to the flora of Mackenzie District.

SALICACEAE

*Salix maccalliana* Rowlee Occasional in *Salix* transition between *Picea glauca* woods and sedge meadow, one half mile northeast of Mackenzie River opposite Fort Simpson, *11338*.

Previously recorded in southwestern Mackenzie District from Fort Smith (Cody, 1956), along the Mackenzie River–Fort Rae highway and Enterprise–Mackenzie River highway (Thieret, 1961) and in the Mackenzie Lowlands adjacent to the Liard River between the British Columbia border and Nahanni Butte (Jeffrey, 1961). Our collection is the northernmost yet found along the Mackenzie River.

*Salix mackenzieana* Barratt Scattered along shrub border back from shore, island in Liard River 15 miles southwest of Fort Liard, *11493;* bank of creek, Liard River 1 mile above Blue Bill Creek, 42 miles north of Fort Liard, *11943*.

Previously recorded from the Liard River between the B.C. border and Nahanni Butte (Jeffrey, 1961) but without exact locality. This species is found along the Mackenzie River perhaps as far downstream as Fort Norman, in the Peace River Region and southern Yukon (Raup, 1959).

*Salix pyrifolia* Anders. Rare in open black spruce muskeg, west shore of Liard River 14 miles southwest of Fort Liard, *11626;* at edge of *Sphagnum*-sedge meadow, Liard River 7 miles below Blue Bill Creek, 44 miles north of Fort Liard, *11983;* southeast shore Hearne Lake, 62°20′N, 113°08′W, *G. W. Scotter, 965 and 967* (DAO); northwest side, Gordon Lake, 63°10′N, 113°10′W, *G. W. Scotter, 1248* (DAO).

Until this species was recorded by Thieret (1962) from along the Mackenzie River–Yellowknife Highway the only record of this species occurring in Mackenzie District was that of Raup (1959): ". . . Porsild (personal communication) has a record for it in the southeastern corner of the District of Mackenzie . . .". Scotter's collections extend the known range of this species north of Great Slave Lake to the east while our collections along the Liard extend the range into southwestern Mackenzie District.

*Salix alaxensis* (Anders.) Cov. Bank of creek, Liard River, 1 mile above Blue Bill Creek, 42 miles north of Fort Liard, *11945;* rare along creek bank, middle slope of Mount Flett, 32 miles north of Fort Liard, *11881;* sandy gravel in partial shade at back of beach, west end of Cli Lake, *12194;* rare in creek bed, middle slope of Nahanni Range, west end of Cli Lake, *12297;* moist tundra slope by creek, middle slope of Nahanni Range, west end of Little Doctor Lake, *12162.*

In southwestern Mackenzie District, this willow has been recorded from several places in the Mackenzie Mountains (Raup, 1947) but it was apparently previously unknown from the area adjacent to the Liard River.

*Salix scouleriana* Barratt var. *coetanea* Ball Occasional on steep rocky slope with *Populus* and among *Populus* on open slopes about lake, Little Doctor Lake, *12137, 12093.*

Previously recorded for southwestern Mackenzie District from Liard River between the British Columbia border and Nahanni Butte, where I have also collected it (Jeffrey, 1961), Mackenzie Mountains (Raup, 1947; Porsild, 1945) and Fort Simpson (Cody, 1961).

### POLYGONACEAE

*Polygonum aviculare* L. *s.l.* Common along trails throughout settlement, Fort Liard, *11715.*

Not previously recorded from along that part of the Liard River lying in southwestern Mackenzie District (see Cody, 1960 for discussion).

*Polygonum achoreum* Blake Common along edges of paths between buildings, Jean-Marie River at Mackenzie River, 61°32′N, 120°38′W, *11424;* common along trails throughout settlement, Fort Liard, *11714.*

Previously known from a number of townsites in southwestern Mackenzie District (Cody, 1956, 1961) but hitherto unrecorded from along that portion of the Liard River in the District; a native species, undoubtedly introduced in our area.

*Polygonum amphibium* L. var. *stipulaceum* (Coleman) Fern. Wet clay banks of river, Petitot River near its mouth on Liard River, Fort Liard, *11721.*

In southwestern Mackenzie District previously recorded from Great Slave Lake and as far down the Mackenzie River as Fort Simpson; our specimens differ from the description given by Fernald (1950) in having pubescent pedicels as in *P. coccineum* but lack the strigose pubescence on the *ocreolae* which is found in that species.

*Polygonum convolvulus* L. Occasional weed in potato field, Browning's Farm on Mackenzie River 4 miles east of Trout River, 61°17′N, 119°47′W, *11377;* twining among other vegetation on Liard River bank in front of settlement, Fort Liard, *11693.*

Introduced; previously known in Mackenzie District from Fort Smith, Yellowknife, Fort Providence and Fort Simpson (Cody, 1956, 1961); this weedy species will probably eventually turn up in most of the settlements in southwestern Mackenzie District.

### CARYOPHYLLACEAE

*Stellaria crassifolia* Ehrh. In moss among rocks by lake shore, west end of Cli Lake, *12277.*

Not previously known from southwestern Mackenzie District (Raup, 1947) although it is known from the northern part of the District (Porsild, 1943), Yellowknife (Cody, 1956) and Wood Buffalo Park (Raup, 1936).

*Stellaria media* (L.) Cyrill Common weed in and about gardens, Fort Liard, *11716;*

occasional in cabin clearing, Nahanni Butte Settlement, *12014.*

An introduced weed; previously recorded from Mackenzie District from several settlements (Raup, 1947; Cody, 1956, 1960); it will probably eventually turn up in most of the townsites in the region.

*Arenaria dawsonensis* Britton Rare, cut bank of creek, middle slope of Mount Flett 32 miles north of Fort Liard, *11885;* in shallow soil among stones on steep slope, Nahanni Butte, *12048;* rare, moist eroding creek bank, west end of Cli Lake, *12320.*

Apparently rare; not previously known from the slopes adjacent to the Liard River but recorded from Brintnell Lake and Lone Mt. in the Mackenzie mountains to the north.

### RANUNCULACEAE

*Ranunculus sceleratus* L. var. *multifidus* Nutt. Rare in humus of recently cleared bush land, Nahanni Butte Settlement, *12006.*

Apparently rare in southwestern Mackenzie District; previously known in the Mackenzie River Valley; our specimens are quite small, measuring only 4-7 cm in height, but are otherwise quite typical.

### CRUCIFERAE

*Draba lanceolata* Royle In shallow soil among stones on steep open slope, Nahanni Butte, *12037;* rare on steep open slope overlooking lake, Little Doctor Lake, *12095;* rare, crevice on rock ledge, lower slope of Nahanni Range, west end of Cli Lake, *12241.*

Raup (1947) recorded only three collections of this species from southwestern Mackenzie District, all from Colonel Mt.; Thieret (1961) has since collected it along the Mackenzie—Enterprise Highway; our collections are all from the Nahanni Range of the Mackenzie Mountains.

*Draba nemorosa* L. var. *leiocarpa* Lindbl. Waste ground in townsite, Fort Liard, *11725.*

Previously recorded in Mackenzie District from Fort Smith, Resolution, Fort Simpson, Norman Wells and Yellowknife (Raup, 1947; Cody, 1956, 1960), but hitherto unknown from along the Liard River.

*Lesquerella arctica* (Wormsk.) Wats. Rare on rocky foothills, Nahanni Range at west end of Little Doctor Lake, *12125;* rare, steep tundra slope, middle slope of Nahanni Range, west end of Little Doctor Lake, *12155;* rare, shallow soil on rock ledge, west end of Cli Lake, *12258.*

Apparently rare in southwestern Mackenzie District; Raup (1947) recorded only one station: near mouth of North Nahanni River; Hooker (1829-40) *sub Vesicaria arctica* recorded another station ". . . on the summit of a hill 700 feet high, at Bear Lake River. . ."

*Lepidium bourgeauanum* Thell. Rare in cabin clearing, west shore of Liard River 8 miles southwest of Fort Liard, *11651;* scattered on Liard River bank in front of settlement, Fort Liard, *11684.*

Not previously recorded from along the Liard River in Mackenzie District; see Cody (1960, 1961) for distribution of this species in Mackenzie District.

*Lepidium densiflorum* Schrad. var. *densiflorum* Occasional in cabin clearing, Nahanni Butte settlement, *12019.*

Not previously recorded from along the Liard River in Mackenzie District; see Cody (1961) for distribution of this species in Mackenzie District.

*Capsella bursa-pastoris* (L.) Medic Rare in cabin clearing, west shore of Liard River 8 miles southwest of Fort Liard, *11652;* common weed in gardens and in waste ground throughout the settlement, Fort Liard, *11724;* common in disused garden in cabin clearing, Liard River at mouth of Netla River 8 miles south of Nahanni Butte, *11989;* common in cabin clearing, Nahanni Butte settlement, *12011.*

Introduced; previously known at Fort Simpson (Raup, 1947) and other settlements along the Mackenzie River and about Great Slave Lake (Cody, 1956, 1960, 1961) and certainly to be expected in settled areas along the Liard River.

*Descurainia sophia* (L.) Webb. Rare in cabin clearing, west shore of Liard River 8 miles southwest of Fort Liard, *11646.*

Introduced; previously known from a number of stations along the Mackenzie River and about Great Slave Lake (Cody, 1956, 1960, 1961) but hitherto unrecorded from along the Liard River; apparently

spreading rather quickly in settled areas in southern Mackenzie District.

*Descurainia richardsonii* (Sweet) O. E. Schulz Rare in cabin clearing, west shore of Liard River 8 miles southwest of Fort Liard, *11647*.

Not previously recorded from that part of the Liard River flowing through southern Mackenzie District, but known from numerous sites along the Mackenzie River and eastward in Mackenzie District (Raup, 1947; Cody, 1956, 1960).

*Erysimum cheiranthoides* L. Rare in cabin clearing, west shore of Liard River 8 miles southwest of Fort Liard, *11645;* in waste ground of settlement and along Liard River bank, Fort Liard, *11711*.

Not previously known from along the Liard River but recorded from a number of stations along the Mackenzie River and to the eastward in southern Mackenzie District (Raup, 1947; Cody, 1960).

*Arabis hirsuta* (L.) Scop. var. *pycnocarpa* (Hopkins) Rollins Steep open bank of creek, lower slopes of Mount Flett 32 miles north of Fort Liard, *11877;* steep eroding bank of creek, west end of Cli Lake, *12249*.

Apparently rare in the Liard River region: Jeffrey (1961) recorded it from the Kotaneelee River southwest of Fort Liard and Raup (1947) has it from Fort Simpson from whence I also have several collections.

*Arabis divaricarpa* A. Nels. Rare, gravelly bank of Petitot River ½ mile upstream from Liard River, Fort Liard, *11737*.

Previously recorded from along the Liard River but without exact locality (Raup, 1947): "between Nahanni Butte and Simpson. . ."

*Brassica napus* L. Rare at edge of garden, Browning's Farm on Mackenzie River 4 miles east of Trout River, *11378*.

Persisting after cultivation; not previously recorded for Mackenzie District.

*Sinapis arvensis* L., *Brassica kaber* (D.C.) Wheeler var. *pinnatifida* (Stokes) Wheeler Weed in barnyard, Browning's Farm on Mackenzie River 4 miles east of Trout River, *11379*.

A casual introduction; previously known in Mackenzie District from a single collection from Fort Simpson (Raup, 1947).

SAXIFRAGACEAE

*Saxifraga aizoides* L. Rare in moist creek bed among stones, middle slope of Mount Flett, 32 miles north of Fort Liard, *11892*.

The only other record from along the Liard River is the rather vague locality of a Crickmay specimen cited by Raup (1947) ". . . between Nahanni Butte and Simpson. . ."

ROSACEAE

*Potentilla pensylvanica* L. Occasional in sod at top of bank overlooking Liard River, Fort Liard, *11705;* in shallow soil among stones on steep open face, Nahanni Butte, *12029*.

In southwestern Mackenzie District previously known from Fort Simpson, Fort Providence, Hay River, Yellowknife and Fort Smith, but unrecorded from the Liard River.

*Geum aleppicum* Jacq. var. *strictum* (Ait.) Fern. Rare in cabin clearing, west side of Liard River 18 miles southwest of Fort Liard, *11602;* rare, occasional clump in cabin clearing, west shore of Liard River 8 miles southwest of Fort Liard, *11656;* occasional on Liard River bank in front of settlement, Fort Liard, *11687;* occasional in cabin clearing, Liard River at mouth of Netla River, 8 miles south of Nahanni Butte, *11996*.

Jeffrey (1961) noted *Geum* only once during his survey, and that was *G. perincisum* (*G. macrophyllum* var. *perincisum*). Raup (1947) reported our species from Fort Simpson, from whence I have also collected it, as a range extension from Wood Buffalo Park. We also have specimens from Fort Providence and Mills Lake on the Mackenzie River. Our collections were all made around habitations so there is a possibility that this species might be introduced here.

*Prunus pensylvanica* L. f. A few shrubs to 4 ft. in height near top of steep bank overlooking Petitot River ½ mile upstream from Liard River, Fort Liard, *11742;* a few shrubs to 2½ ft. in height in clearing near summit of Mount Coty, alt. 2700 ft., 60°18′N, 123°30′W, *11790;* rare, shrubs to 3 ft. in height, steep open bank of creek, middle slope of Mount Flett, 32 miles north of Fort Liard, *11880;* beaten shrubs to 2 ft. in height in shallow soil among stones on steep slope, Nahanni Butte, *12053;* shrub 18 inches in

height, rare on steep open slope of Nahanni Range at west end of Little Doctor Lake, *12087;* shrub 18 inches high, banks of creek, lower slope of Nahanni Range, west end of Cli Lake, *12286;* shrubs 2 to 5 ft. in height, rare among *Shepherdia, Rosa, Amelanchier* and *Populus* at top of bank overlooking junction of Harris Creek and Mackenzie River opposite Fort Simpson, *11487.*

Although Preble (1908) states that this species is "... common along the Athabaska and Slave rivers and about the great lakes into which they flow", Raup (1947) recorded only one collection from southwestern Mackenzie District. This was from Liard River between Nahanni Butte and Simpson. Thieret (1961) has since collected it along the Mackenzie–Enterprise Highway at the west end of Great Slave Lake. Along the Liard River, *P. pensylvanica* is found on steep slopes where there is little competition with the common boreal species.

### LEGUMINOSAE

*Trifolium hybridum* L. Occasional in cabin clearing, Nahanni Butte Settlement, *12012.*

Introduced; previously known in Mackenzie District from Fort Smith, Hay River and Yellowknife (Cody, 1956).

*Melilotus officinalis* (L.) Lam. At edge of garden, Fort Liard, *11760.*

Introduced; previously known in Mackenzie District from Fort Smith, Hay River, Yellowknife, Fort Providence and Fort Simpson (Cody, 1956, 1961).

*Melilotus alba* Desr. At edge of garden, Fort Liard, *11761.*

Introduced; previously known in Mackenzie District from Fort Smith, Alexandra Falls, Hay River, Yellowknife, Mills Lake and Fort Simpson (Cody, 1956, 1961).

*Astragalus canadensis* L., *A. americanus sensu* Jeffrey (1961) Kotaneelee River, *Jeffrey, 112* (CAN); rare among open *Populus balsamifera* and *Equisetum hiemale,* island in Liard River 15 miles southwest of Fort Liard, *11505;* in sod on bank of Liard River, Fort Liard, *11709;* occasional on steep bank of Petitot River ½ mile upstream from Liard River, Fort Liard, *11744;* in shallow soil among stones on steep open slope, Nahanni Butte, *12036.*

The northernmost locality previously recorded for this species was Fort McMurray (Raup, 1936) some 500 miles to the southeast. Raup (1934) did not record *A. canadensis* from the Peace River District but there are a number of recent collections from that region in the Department of Agriculture Herbarium (DAO); Alberta: Watino, Lake Saskatoon, Vermilion, and Beaverlodge; British Columbia: Fort Nelson, NE. of Hudson Hope, Fort St. John and Alexandria. It is new to the flora of Mackenzie District.

*Astragalus yukonis* M. E. Jones Occasional, gravelly bank of Petitot River ½ mile upstream from Liard River, Fort Liard, *11734.*

Hultén (1941-52) stated that he knew this species from Nahanni R., but Raup (1947) recorded only his own collections from near Fort Simpson. Elsewhere in Mackenzie District *A. yukonis* is known from the Mackenzie Delta, Yellowknife, Mills Lake, west of Fort Smith, Alexandra Falls and Hay River.

### VIOLACEAE

*Viola nephrophylla* Greene In sod among stones on shore line, Little Doctor Lake, *12107.*

This is the second record of this species for Mackenzie District; Thieret (1961) collected it near Kakisa Lake some 150 miles to the southwest of our station and Raup (1935, 1936) has it from Wood Buffalo Park in northern Alberta.

### ONAGRACEAE

*Epilobium latifolium* L. Gravel creek bed, lower slopes of Mount Flett, 32 miles north of Fort Liard, *11873;* gravel creek bed, lower slope of Nahanni Range at west end of Cli Lake, *12244.*

Although known from several localities in the Mackenzie Mountains (Raup, 1947; Porsild, 1945), not previously recorded from the slopes adjacent to the Liard River.

*Epilobium palustre L. s.l.* In sedge meadow, Liard River 7 miles below Blue Bill Creek, *11967;* occasional in wet moss bordering small slough in bush, on mainland about 1 mile south of Fort Simpson island, *9122;* localized in moist open ground of trail

through bush behind R.C. Mission Farm, Fort Simpson, *8843;* rare by dried up slough behind Community Centre, Fort Simpson, *8752;* in wet moss by slough near Royal Canadian Corps Signals Transmitters, Fort Simpson, *8905, 9273.*

This is a wide-ranging species which extends northward to the arctic coast, but has been found only a few times in southern Mackenzie District (Raup, 1947; Thieret, 1961; Cody, 1960); not previously recorded from along the Liard River.

*Epilobium glandulosum* Lehm. var. *adenocaulon* (Hausskn.) Fern. Scattered on steep eroding alluvial bank of river, west side of Liard River 18 miles southwest of Fort Liard, *11524;* among *Salix, Alnus* and *Betula,* Liard River 2 miles above Blue Bill Creek, *11924;* among *Equisetum arvense* on steep moist sandy river bank, Liard River 1 mile above Blue Bill Creek, *11941;* occasional in cabin clearing, Liard River at mouth of Netla River 8 miles south of Nahanni Butte, *11994.*

This plant was found by Jeffrey (1961) at Fort Liard, but was not noted elsewhere along the Liard River by him.

### UMBELLIFERAE

*Osmorrhiza obtusa* (Coult. & Rose) Fern. Occasional in *Betula papyrifera, Populus, Picea* woods among other forbs and grasses, Mount Coty, 60°18'N, 123°30'W, 2500 ft. *11787.*

This is a northward extension of range of some 300 miles from the Peace River District of Alberta; it was not recorded by Porsild (1951) from southeastern Yukon Territory; the map in Hultén (1941-52) shows collections from the coastal region of southern Alaska and northwestern British Columbia; new to Mackenzie District.

*Cicuta bulbifera* L. Marshy shore of lake, west end of Cli Lake, *12333.*

This is the third record for *C. bulbifera* from Mackenzie Distirct; the only other records are from Norman Wells (Cody, 1960) and near Yellowknife (Thieret, 1962).

*Cicuta maculata* L. var. *angustifolia* Hook. Wet clay banks of river, Fort Liard, *11723B;* moist silt on river bank, Liard River at mouth of Netla River, *12003;* rare on moist stony shoreline of lake, Little Doctor Lake, *12073.*

New to the flora of Mackenzie District.

*Cicuta mackenzieana* Raup In sedge meadow, Liard River below Blue Bill Creek, 44 miles north of Fort Liard, *11972.*

Jeffrey (1961) noted this species only once in the area of his survey (Fisherman Lake, near Fort Liard).

### ERICACEAE

*Arctostaphylos alpina* (L.) Spreng. Rare in shallow soil over rock in wind-blown clearing on summit of Mount Coty, 60°18'N, 123°30'W, *11796.*

This is an extension of range of some 300 miles southeast in the Mackenzie Mountains from Macmillan Pass where Porsild (1945) reported it as common. The red-fruited *A. rubra* was reported from the Liard region by Jeffrey (1961) and I also made several collections.

### PRIMULACEAE

*Primula stricta* Hornem. In partial shade in shallow soil over gravel of creek bank, lower slopes of Mount Flett 32 miles north of Fort Liard, *11868;* moist open slope by creek, middle slope of Nahanni Range, west end of Cli Lake, *12292.*

Although *P. stricta* is recorded by Raup (1947) as occurring along the Mackenzie River to the arctic coast this species has not previously been reported from the Mackenzie Mountains or the terrain adjacent to the Liard River.

*Lysimachia thyrsiflora* L. Rare in moist silt in sedge meadow, Browning's Farm 4 miles east of Trout River on Mackenzie River, *11396.*

This is the second record of this species from the Mackenzie lowlands, and is the northernmost yet recorded from along that river. It is known from several stations around the western half of Great Slave Lake (Cody, 1956; Raup, 1947; Thieret, 1961) but is apparently quite rare.

*Androsace septentrionalis* L. In shallow soil among stones on steep open face, Nahanni Butte, *12027.*

Previously known from along the Mackenzie River (Raup, 1947) but not along the Liard, although certainly to be expected.

### GENTIANACEAE

*Gentianella amarella* (L.) Borner ssp. *acuta* (Michx.) J. M. Gillett, *Gentiana amarella* sensu Raup (1947). Occasional in sod at top

of bank overlooking Liard River, Fort Liard, *11706;* rare on creek bank, middle slope of Mount Flett, 32 miles north of Fort Liard, *11893;* rare among *Calamagrostis* in clearing among *Alnus, Betula* and *Salix,* Liard River 42 miles north of Fort Liard, *11920A;* in shallow soil among stones on steep slope, Nahanni Butte, *12050;* rare on steep openly wooded slope by lake, Little Doctor Lake, *12080;* moist slope, west end of Cli Lake *12314.*

Not previously recorded from along the Liard River in Mackenzie District, but known along the Mackenzie River as far north as Norman Wells (Cody, 1960).

*Gentianella detonsa* (Rottb.) G. Don spp. *raupii* (Porsild) J. M. Gillett, *Gentiana raupii* Porsild Rare in sod of cabin clearing, Nahanni Butte Settlement, *12060.*

Rare; Jeffrey (1961) observed this species only once along the Liard River; it occurs along the Mackenzie River as far north as the delta.

*Menyanthes trifoliata* L. In wet *Sphagnum* in open black spruce muskeg, west shore of Liard River 14 miles southwest of Fort Liard, *11621.*

This is apparently the first collection from along the Liard River in Mackenzie District; along the Mackenzie River however it is recorded from as far north as the delta and the Eskimo Lake Basin (Porsild, 1943).

### APOCYNACEAE

*Apocynum androsaemifolium* L. Steep eroding bank of Petitot River near its mouth on Liard River, Fort Liard, *11719;* on steep south facing clay boulder bank of Rabbitskin River one mile upstream from Mackenzie River, 61°47′N, 120°42′W, *11462.*

Rare in Mackenzie District even though Hooker (1829-40) recorded it as "throughout the woody country . . .". Previously known from Fort Smith, northwest shore of Great Slave Lake (Raup, 1936, 1947), Fort Simpson (Cody, 1961) and Nahanni Butte (Jeffrey, 1961).

### HYDROPHYLLACEAE

*Phacelia franklinii* (R. Br.) Gray Steep eroding bank of creek, foothills of Nahanni Range at west end of Cli Lake, *12250;* rocky area in mature forest, southeast shore Hearne Lake, 62°20′N, 113°08′W, *G. W. Scotter, 957* (DAO); sandplain, Gordon Lake, *W. E. Denton, s.n.* (DAO).

Raup (1947) cited three collections from around Great Slave Lake and a *Richardson* collection labelled "Cumberland House to Bear Lake". Hooker (1829-40) stated the distribution as "From the Saskatchewan to the Bear Lake and English Rivers". The latter two citations are typical of the vague locality data given at that time. The collections cited here are the first with exact localities from north of the shores of Great Slave Lake.

### OROBANCHACEAE

*Boschniakia rossica* (Cham. & Schl.) Fedtch. Growing under and parasitic on the roots of *Alnus crispa* just below Big Island on Liard River 60°31′N 123°30′W.

Not previously recorded from the area adjacent to the Liard River, but Raup (1947) has recorded it from Brintnell Lake in the southern Mackenzie Mountains and from Fort Simpson, where I have also collected it.

### LENTIBULARIACEAE

*Pinguicula vulgaris* L. In partial shade in shallow soil over gravel of creek bank, lower slopes of Mount Flett, 32 miles north of Fort Liard, *11867;* in shallow soil in moist crevice by creek, middle slope of Nahanni Range, west end of Little Doctor Lake, *12164;* moist open slope by creek, middle slope of Nahanni Range, west end of Cli Lake, *12295.*

Previously recorded from the Mackenzie Mountains only three times: Lone Mt., Bolstead Creek (Porsild, 1945; Raup, 1947) and Dodo Canyon (Cody, 1960). There are numerous collections from elsewhere in Mackenzie District, particularly around Great Slave Lake.

### RUBIACEAE

*Galium trifidum* L. In sedge meadow, Liard River 7 miles below Blue Bill Creek, 44 miles north of Fort Liard, *11968;* in moist moss over stones in partial shade of *Betula glandulosa* and *Salix* along shoreline, west end of Cli Lake, *12327.*

Jeffrey (1961) reported the somewhat similar *G. labradoricum* from the Liard River region but did not find our species. *G. trifidum* was collected by Raup (1947) at Fort Simpson, where I have also collected it, and it is known as far down the Mackenzie River as the delta (Porsild, 1943).

COMPOSITAE

*Antennaria pulcherrima* (Hook.) Greene Rare, moist ground by creek, middle slope of Mount Flett, 32 miles north of Fort Liard, *11890.*

Not previously known from along the Liard except at Fort Simpson (Cody, 1961).

*Artemisia frigida* Willd. Steep eroding bank of Petitot River near its mouth on Liard River, Fort Liard, *11717;* crevice on rock ledge, lower slope of Nahanni Range west end of Cli Lake, *12239.*

Apparently rare in our area, but known along the Mackenzie River north to its mouth on the arctic coast (Raup, 1947). Jeffrey (1961) saw this species only at Nahanni Butte, where I have also collected it.

*Taraxacum officinale* Weber Along trails and in waste ground and lawns, Fort Liard, *11764;* occasional in cabin clearing, Nahanni Butte Settlement, *12013.*

Introduced; not previously known from along the Liard River, but recorded from several inhabited areas in southern Mackenzie District (Cody, 1956, 1961).

*Matricaria matricarioides* (Less.) Porter Along trails and in waste ground and lawns, Fort Liard, *11765;* rare in cabin clearing, Nahanni Butte Settlement, *12021.*

Introduced; previously recorded from several settlements in Mackenzie District (Cody, 1956, 1960, 1961) but hitherto unknown from along the Liard River.

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# REVIEWS

**Birds from Britannia**

BY H. R. H. THE DUKE OF EDINBURGH. Longmans, Green and Co., London. 1962. 62 pp. 72 photos. 8 plates of drawings. $4.95.

This book is primarily a collection of black and white photographs taken during the course of Prince Phillip's world tours on the royal yacht Britannia in 1956 and 1959. Most of the photographs are of birds, a few of dolphins, seals etc. They are beautifully printed on glossy paper, and make on the whole a very attractive set of portraits of sea birds. Unfortunately, moving sea birds are exceedingly difficult to photograph, and light conditions are often poor. As a result, about a dozen of the seventy-two photographs are not sharp. In some the light was poor and the wide open lens did not give enough depth of focus to make the whole bird sharp; in others the shutter speed was not fast enough to stop the action. Some are only slightly soft in outline, but others make a person downright seasick to look at them. I feel that it would have improved the book considerably to have left these last cut completely.

The text and pictures are arranged from north to south: the tropical seas, the southern oceans and the sub-antarctic and antarctic. Various penguins, terns, noddies, boobies, albatrosses and frigatebirds, of which we occasionally see pictures, are included. But there are among them Sheathbills, flightless Steamer Ducks, Pintado Petrels and others which are very rarely photographed. This is the principal value of the book.

The first half of the text consists of Prince Phillip's diary-like account of the places where the photographs were taken, primarily islands in the South Atlantic and South Pacific. He tells of the topography of the islands, their people and boats, but gives no technical photographic details. It is an interesting account but sparse. The end papers are maps of the expeditions, a very necessary reference.

The second half of the text consists of general notes on the birds by Captain G. S. Tuck. For each bird there is a short very general paragraph, containing little which could not be learned from Alexander's *Birds of the Ocean*. Also in this second part are eight plates of very fine drawings by Commander A. M. Hughes of most of the birds in the book.

This is not a necessary book on the shelf of a bird-watcher, but it would make a nice extra, or an attractive gift.

NANCY M. MCALLISTER

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Ottawa, Ontario

**The Cry of a Bird**

BY DOROTHY YGLESIAS. William Kimber, London. (*In Canada,* The Ryerson Press, Toronto) 1962. 168 pp. plus many illustrations. $4.50.

By chance, two sisters cared for a Jackdaw with a broken wing that had sought refuge in a drainpipe. That was in 1928 and was the beginning of *The Wild Birds' Hospital and Sanctuary* at Mousehole, three miles west of Penzance, Cornwall.

Although the two sisters were busily engaged in earning a living, one by wood-carving, and the author by gardening, they still managed over the years to care for about 4,000 bird patients, some oiled, some wounded, some merely in need of temporary help.

The naturalist will be interested in their efforts, and especially in the many keen observations on the totally different reactions of birds of the same species under similar circumstances.

Occasionally the patients were condemned to life in captivity; all were cared for; all were studied.

A whole community was converted to the study and care of birds and, ultimately, at the end of 1959, worries for the future of the hospital ceased when the Royal Society for the Prevention of Cruelty to Animals took over the responsibility completely and the new entrance board now reads: *The R.S.P.C.A. Wild Birds' Hospital.*

HOYES LLOYD

**La Vie des Colibris (Les Trochildés)**

BY ARIANE MARTIN and ANNE MUSY. Delachaux & Niestlé S. A., Neuchâtel, Switzerland, 1959. 246 pp. plus 32 coloured plates plus 70 figures in the text. About $6.50.

Of special attraction is this inexpensive, concise, yet comprehensive treatise on one of the smallest denizens of the forest environment – the hummingbird. Comprising over a thousand species or subspecies and distributed throughout the New World from Tierra del Fuego in the south to Alaska and Newfoundland in the north, the hummingbird has fascinated man ever since Jean de Léry's first-known account in 1557. Much literature exists on this unique family of avian travellers, ranging from the exquisite descriptive productions of the nineteenth century to the technical papers of the twentieth. The authors achieve a nice balance between these extremes and have brought together in one volume widely scattered material that will interest both the naturalist and the more serious student of biology. Chapters are devoted to history, distribution, anatomy, temperature regulation, locomotion, nutrition, reproduction and behaviour. There is an excellent bibliography to each chapter and an index to the coloured plates. The latter illustrate the various species against their characteristic habitat, and in their particular style seem to portray aptly the iridescent evanescence so typical of the natural scene.

The book is very well produced and the straightforward French text should present no special problem. It will find a niche on many a bookshelf.

P. J. RENNIE

Canada Department of Forestry
Chalk River, Ontario

**The Birds of Nova Scotia**

BY ROBIE W. TUFTS, illustrated in color by Roger Tory Peterson and John Crosby, with line drawings by John H. Dick. Nova Scotia Museum, Halifax. 1961 (= 1962), pp. i-xvii, 1-481, 40 colored plates. ($7.50).

Long experience, acquired during sixty years of bird study in Nova Scotia, has equipped the author well to write on the birds of his native province. The book is profusely illustrated by three outstanding artists. The result is an authoritative and handsome volume.

The author, in the course of his long personal experience in the province, has noted interesting changes in the status of many species there. Some have declined

in numbers, matching similar trends elsewhere on the continent. It is, however, some of those that have shown marked increases that are of particular interest and significance. It will surprise many to learn that the Common Grackle, Brown-headed Cowbird, and Horned Lark, all common and widely distributed on the continent, have only recently colonized Nova Scotia as breeding birds and become common in the province only since the turn of the present century. The Red-winged Blackbird is another recent arrival and its spread, apparently through the neck of the peninsula, is indicated. The Eastern Meadowlark, Mourning Dove, and Evening Grosbeak are now endeavoring to establish breeding populations as is shown by recent sporadic nestings. Other species of wide distribution in much of southeastern Canada but which have not yet established breeding populations in Nova Scotia include Red-shouldered Hawk, Screech Owl, Eastern Phoebe, House Wren, and Long-billed Marsh Wren.

Three hundred and forty-nine species and subspecies are treated. Of these nineteen are given hypothetical status. A total of 160 species are known to nest or to have nested in the province. A high proportion of accidentals in the Nova Scotia list, mostly storm-borne, is to be expected because of the geographic position of the province.

For each species there is a detailed and well-documented account of the status in Nova Scotia. For each species of regular occurrence, a succinct description of plumage and appearance is given. For species that breed in the province, there is an account also of the nest, nest site, and nest composition; the eggs (clutch size and color); egg dates; and often various useful original data on aspects of nesting. The overall range of the species is given, and finally there is a *Remarks* section containing general information on the species concerned.

The introduction contains a description of the province with emphasis on topography, climate, vegetation, and geology. There is a ten-page bibliography and an index.

The book is well printed and typographical errors are remarkably few. The publication date, however, on the title page is given as 1961 although actual publication was late in 1962.

The book is beautifully and profusely illustrated. About 225 species are depicted in color on forty plates. Thirty-two of the plates, by Roger Tory Peterson, were used previously to illustrate the very successful book by Peters and Burleigh, *The Birds of Newfoundland*. An additional seventy-two species of regular occurrence in Nova Scotia, although crowded onto eight plates, are well illustrated in color by John Crosby. Thirty pleasing line drawings by John H. Dick are scattered through the text.

It seems almost too good to be true that such an impressive volume can still be marketed for such a modest price.

W. EARL GODFREY

# NOTES

## Additions to the Flora of the Northwest Territories

During the course of botanical field work along the Great Slave Lake Highway in August, 1962, I collected the following species that apparently have not been previously recorded, with authenticating specimens, from the Northwest Territories. The field work was supported by a grant from the National Science Foundation. The specimens are deposited in the Herbarium of the Canada Department of Agriculture (DAO). The collection numbers cited are those of the author.

*Phalaris canariensis* L. Weedy area on bluff overlooking Mackenzie River 4 miles east of Fort Providence, *9434*.

*Secale cereale* L. Roadside forty-eight miles north of Mackenzie River, *9104*.

*Acorus calamus* L. Local, with *Calla palustris, Menyanthes trifoliata* and *Potentilla palustris*, in mat around pond, along road about three miles south of Fort Rae, *9484*. This collection extends the authenticated range of the sweet flag some 550 miles north from what was apparently the northernmost previous collection, that of Cody (1957, Canadian Field-Naturalist 70: 108) from Lac La Biche, Alberta. Breitung, in his "Anotated Catalogue of the Vascular Flora of Saskatchewan" (1957, American Midland Naturalist 58: 1-72), records the species from no further north than Prince Albert National Park, which is about 700 miles southeast of the Fort Rae locality. However, Dr. William J. Cody has drawn my attention to the fact that *Acorus calamus* was mentioned by Emile Petitot (1891, *Autour du Grand Lac des Esclaves*) as occurring near Lac la Martre, some sixty-five miles northwest of Fort Rae.

*Axyris amaranthoides* L. Rare in disturbed sandy soil at roadside, Enterprise (Mile 0 of Great Slave Lake Highway), *9042a*.

*Elatine triandra* Schk. (var. *triandra*). Common, with *Callitriche*, in mud on shore or in shallow water of roadside pond about twenty-five miles northwest of Yellowknife, *9286*.

*Lappula echinata* Gilib. Infrequent in disturbed sandy soil at roadside, Enterprise (Mile 0 of Great Slave Lake Highway), *9051a*.

*Gnaphalium uliginosum* L. Infrequent in wet sand and in shallow water of Prosperous Lake, about eleven miles northeast of Yellowknife, *9238*.

John W. Thieret

University of Southwestern Louisiana
Lafayette, Louisiana
23 November 1962

## Note on *Anagaudryceras sacya* (Forbes)*

Speciation in the ammonoid genus *Anagaudryceras* Shimizu has been largely based on characters of the inner whorls. More consideration, however, should be given to characters of the adult whorls and their sequence. Specimens of *Anagaudryceras sacya* (Forbes) in the Lower Cretaceous Haida Formation of the Queen Charlotte Islands, B.C., have beyond a stage of sparsely distributed costae ("periodic ridges") and constrictions, one of wide, flat ribs separated by narrow constrictions, one of plane-slant narrow ribs separated by furrows asymmetrical in tangential section and one of asymmetrical to bilaterally symmetrical, round ribs, separated by deeper and wider, asymmetrical to bilaterally symmetrical furrows. The plane-slant ribs are narrow and each has a plane surface which slopes adapically. The diameter varies at which each rib stage enters during growth of the shell. Modifications

of these rib stages and their sequence are considered to provide important criteria for speciation in the genus *Anagaudryceras.*

F. H. McLEARN

817 Ivanhoe Ave.
Ottawa, Ontario
7 December 1962
*Published with the permission of the Director of the Geological Survey of Canada.

## *Catharacta skua* Brünnich sighted in North Pacific

INFORMATION as to the wintering places of southern Skuas seems to be scarce enough to make the following observations of interest. They were made while the writer was on a passage from Tokyo to San Francisco as a passenger in the S. S. *President Hoover.*

*June 6, 1960.* Position 1200 hours 38° 33′ N. 155° 14′E. Southeast wind, cool, overcast, showery, some fog. A gull-sized bird seemed to come aboard at 1215 hours, but although I searched upper deck in a squall of wind and rain it was not found.

*June 8, 1960.* Position 1200 hours, 40° 05′ N. 172° 39′ E. Southeast wind, light overcast. At 1600 hours Mrs. Lloyd saw a black bird, crow-like flight, crow size, flap steadily across the bow.

*June 9, 1960.* Position 1200 hours, 40° 39′ N. 178° 14′ W. Light southeast wind, light cloud. At 615 hours two Skuas flew eastbound parallel to our course and close to the ship passing below me. They played in pursuit of each other and then passed ahead of us with ease. The white wing markings were plainly seen.

On this occasion there was no doubt as to the identity of the species with which I am familiar, and the sightings of June 6 and 8 are presumed to be of the same species. The crow-like flight as reported on the eighth is characteristic, and, although it looks labored at times, this only conceals its great power.

HOYES LLOYD

582 Mariposa Ave.
Ottawa, Ontario
25 January 1963

## Oceanic Crabs Found off the Coast of British Columbia

TWO SMALL CRABS collected off Otter Point (48° 19′ N., 123° 46′ W.) appear to be the first record of the oceanic species *Planes cyaneus* Dana for British Columbia. The specimens were discovered among barnacles, *Lepas anatifera* (Linnaeus), attached to a glass net float picked up by Lieutenant J. R. J. Rangel while aboard the frigate *HMCS Jonquiere* on November 21, 1962. As *Planes cyaneus* has previously been reported only from the central Pacific Ocean in the area from southern Chile to northern California (Fenner A. Chace, Jr., 1951 *The oceanic crabs of the genera* Planes *and* Pachygrapsus. Proceedings of the U.S. National Museum *101* (3272): 65-103), the present record constitutes a considerable extension of the known range.

Chace (*op. cit.*) has clarified much of the confusion that formerly existed regarding oceanic crabs. He recognises three species only: *Planes minutus* (Linnaeus), *P. cyaneus* Dana and *Pachygrapsus marinus* (Rathbun), and of these only the last two are recorded from the Pacific Ocean. Specimens of *P. marinus* collected off Vancouver Island (48° N, 126° W) on March 28, 1958, have already been recorded (Josephine F. L. Hart. 1959. Report of the Provincial Museum 1958, British Columbia, p. C 31).

Oceanic crabs apparently spend most of the time clinging to floating objects of all kinds, including weed, turtles and pelagic gastropods. In this way they become widely distributed. They are capable of swimming but probably not for prolonged periods. This is accomplished by means of the wide flattened legs, the width of which is augmented in the genus *Planes* by a dorsal fringe of hair on the terminal three segments.

JOSEPHINE F. L. HART

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Victoria, B.C.
24 January 1963

## A Sight Record of the Hutton's Vireo in Miracle Beach Provincial Park, Vancouver Island

IN CANADA, the Hutton's Vireo, *Vireo huttoni*, is found only in southwestern British Columbia where it is a scarce resident. It is represented on Vancouver Island by the subspecies *V. h. insularis*.

According to Munro and Cowan (1947. A Review of the Bird Fauna of British Columbia. B.C. Provincial Museum Special Publication 2) this vireo occurs north on the mainland coast at least to Kingcome Inlet, opposite northern Vancouver Island, and on Vancouver Island north to Comox. This note concerns the species at Miracle Beach, about fifteen miles up the coast from Comox. As pointed out to me by R. Y. Edwards, we might expect this rather sedentary resident to occur on the Island at least north to Campbell River. It probably invaded Vancouver Island originally by crossing narrow channels among the many islands between the mainland and Vancouver Island north of Latitude 50°N. From what little is known of its ecological needs, we would expect it to be confined on Vancouver Island to the lowest elevations of the coastal plain along the east side.

Due to its scarcity, this species has been seen by only a few bird watchers in British Columbia. Some observers have probably mistaken it for the Ruby-crowned Kinglet which it closely resembles. The Hutton's Vireo, however, is much less active than the kinglet and does not have the latter's habit of wing fluttering. The bill is heavier and the general body appearance stockier than that of the kinglet.

During the breeding season, the distinctive "zu-weep" call of this vireo may be heard up to a dozen times in succession followed by a period of silence. Occasionally, a husky slurred note is also given, but it is generally much quieter than either the Red-eyed Vireo or the Solitary Vireo. I have often attracted the Hutton's Vireo by imitating Screech Owl or Pygmy Owl calls.

A pair of Hutton's Vireos was observed from March 17 to June 13, 1962, in Miracle Beach Provincial Park Campsite. This area is a mixed second-growth forest, the result of incomplete logging about thirty-five years ago. Munro and Cowan, (*op. cit.*) state that this vireo is found in mature deciduous forests. The territory of the breeding pair was located in particularly dense underbrush consisting mainly of Western Dogwood, Pacific Crabapple and Ninebark. A few Black Cottonwoods and Red Alders provided a light tree canopy. The nest was not located, but both adults were seen feeding a young bird on June 11.

BETTY WESTERBORG

R.R. 1, Black Creek,
British Columbia
7 December 1962

## On the Type Locality of Thirteen North American Birds

ALTHOUGH a type locality is relatively unimportant at the species level, it is important at the subspecies level. In either case it is desirable to establish facts as precisely as possible.

It has been pointed out (Snyder, 1935. *A Study of the Sharp-tailed Grouse.* University of Toronto Studies, Biological Series, 4:36-38) in connection with the Sharp-tailed Grouse that the type locality for that species, and therefore the nominate subspecies, is north-eastern Manitoba; an improvement over the designation, "Hudson Bay" as given in A.O.U. Check-lists (American Ornithologists Union Committee. 1910, 1931, 1957. *Check-list of North American Birds*).

Linnaeus (1758. *Systema naturae* . . . 12th ed.) based his descriptions of twelve forms on the descriptions and illustrations of George Edwards (1750. *A natural history of birds.* Part 3), or, this author and

Mark Catesby (Catesby. 1731. *The natural history of Carolina* . . . vol. 1), in that order. They are as folows:

*Ardea herodias*
*Chen caerulescens*
*Melanitta perspicillata*
*Canachites canadensis*
*Pedioecetes phasianellus*
*Grus canadensis*
*Porzana carolina*
*Limosa fedoa*
*Limosa haemastica*
*Phalaropus fulicarins*
*Lobipes lobatus*
*Progne subis*

An additional species was based on Catesby and Edwards in that order, namely, *Grus americana*. Because of uncertainty as to the origin of Catesby's basic specimen, the A.O.U. Committee takes Edwards as the basis. Accepting this procedure, a total of thirteen Linnaean species of North American birds are based on Edwards.

Edward's pre-Linnaean descriptions and illustrations were based on specimens collected by James Isham between the years 1732 and 1745. These specimens were turned over to Edwards in London between the summers of 1745 and 1746. During the four periods when Isham lived in the New World, he was stationed mostly at York Factory, but briefly at Prince of Wales Fort (= Churchill) (Rich. 1949. *James Isham's observations on Hudson's Bay*, . . . The Champlain Society, Toronto, Appendix C, pp. 318-325).

The only hint that any of Isham's specimens came from other than the environs of these two places, or that he himself collected elsewhere, is that of John Richardson (Swainson and Richardson. 1931. *Fauna boreali-Americana*, 1831, p. 335) who, in a footnote pertaining to the Purple Martin, states that a specimen was "brought from Severn River by James Isham". This statement proves to be unfounded. The Hudson's Bay Company had not occupied Severn River since the French surrender of that region in 1713. Fort Severn was not established until the autumn of 1759, more than a decade after Isham made his collection and turned it over to Edwards.

The substance of the foregoing is that the type locality for the thirteen species listed above can be restricted to northeastern Manitoba.

L. L. SNYDER

Royal Ontario Museum,
University of Toronto,
Toronto, Ontario
13 January, 1963

## The Rediscovery of the Mink Frog in Manitoba

IN 1918 E. T. SETON published the first list of reptiles and amphibians for the province of Manitoba (Ottawa Naturalist 32(5): 79-83). Among the species listed was *Rana septentrionalis* with the notation "recorded by Kennicott as taken at Selkirk Settlement". This locality was apparently based on Cope (1889. *The Batrachia of North America*. United States National Museum Bulletin 34) who lists catalogue no. 5379 as two specimens from Selkirk Settlement collected by R. Kennicott. Stejneger and Barbour (1917, 1923, 1933, 1939, 1943. *Check List of North American Amphibians and Reptiles*) apparently did not use the record as they stated the range (in part) as ". . . west through Michigan to Minnesota, Canada to Hudson Bay". Schmidt, however, in the sixth edition of the Check List (1953) specifically added Manitoba. Mills (1948. *Check List of the Reptiles and Amphibians of Canada*. Herpetologica 4, second supplement, p. 8) states ". . . west to Selkirk in Manitoba". Subsequently Logier and Toner (1955, *Check List of the Amphibians and Reptiles of Canada and Alaska*) cited "Selkirk Settlement (Cope, 1889)" as the only Manitoba locality, and the 1961 second edition of the check list adds no additional Manitoba

localities. Wright and Wright (1949, *Handbook of Frogs and Toads*, 3rd Ed.) and Conant (1958, *Field Guide to Reptiles and Amphibians*) both include southeastern Manitoba in the mapped range. In every case the basis for inclusion of *Rana septrentrionalis* in Manitoba seems to be Cope (1889).

Contrary to the general acceptance, Moore (1952, American Naturalist 86 (826): 5-22) in discussing the Mink Frog range in detail, flatly rejected the record. His decision was based on correspondence with Doris Cochran of the U.S. National Museum who pointed out that the way the original entry was made in the catalogue casts serious doubt as to who collected the specimens and where.

Whatever the status of the "Kennicott" specimens, the presence of *Rana septentrionalis* in the province was established by Dr. R. K. Stewart-Hay (1953, *Frogs in Manitoba*. Manitoba on Display, A Quarterly News Sheet published by the Manitoba Museum (mimeographed). January 1953, pp. 1-2) who stated ". . . could not be placed surely on our records until 1950 when the writer identified an excellent specimen . . . collected . . . by Mr. Burt Kooyman in the Whiteshell Forest Reserve". Through the kindness of Dr. Stewart-Hay the writer examined this specimen. It is a well marked adult female 73 mm snout-anus measurement with the data "8 July, 1950, Longpine Creek (Whiteshell) B. Kooyman". The Whiteshell Forest Reserve lies in southeastern Manitoba north and south of the Trans-Canada Highway, with its eastern boundary along the Ontario border. Subsequently the writer was permitted to examine two additional specimens at the Manitoba Museum and confirm director R. W. Sutton's identification of them as this species. They were collected in August 1950, at "George Lake area" which is also in the Whiteshell Forest Reserve, and measure 62 and 45 mm.

In 1961 and 1962 the writer collected in the Whiteshell Forest Reserve and obtained twelve additional specimens. All were collected at a pond on the north side of Highway No. 1 opposite the turnoff to Falcon Lake. This is a deep bulldozed pond in a roadside clearing, with sparse rushes around the edge. Specimens were collected on June 9, 1961 (2); June 8 (3); June 9 (3); June 10 (1); June 11 (3), 1962. The longest are two adult females 72 and 66 mm. body length. The remainder are juveniles which vary between 45 and 63 mm. Most specimens are characteristically marked and all had mink-like odor at capture. On June 10, 1961, two choruses tentatively identified as *Rana septentrionalis* were heard in the Falcon Lake area.

The existence of *Rana septentrionalis* in extreme eastern Manitoba is definitely established. The "Kennicott" specimens, if their data is valid, although labelled "Selkirk Settlement" were almost certainly from the same general area in eastern Manitoba as the more recent collections and not the present town of Selkirk as assumed by other authors. R. W. Sutton (*pers. comm.*) has pointed out that specimens taken anywhere in eastern Manitoba would likely be labelled Selkirk Settlement as it was the major area of habitation at that time. The Selkirk Settlers settled along the Red and Assiniboine Rivers, an area which is mainly flat prairie grassland and unsuitable for this largely boreal forest species. Thus range maps in Logier and Toner (1955, 1961), Wright and Wright (1949) and Conant (1958) place the western limit of the species too far west.

The writer is indebted to Dr. R. K. Stewart-Hay and R. W. Sutton for permission to examine specimens in their care.

FRANCIS R. COOK

National Museum of Canada,
Ottawa, Ontario
18 January 1963

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# The CANADIAN FIELD-NATURALIST

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## Articles



## Reviews



## Notes



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# The Canadian Field-Naturalist

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## FLORA OF GOOSE BAY, LABRADOR*

JOHN M. GILLETT
Plant Research Institute, Ottawa, Ontario

GOOSE BAY IS A SOUTHWESTERN EXTENSION of Lake Melville into which empty the waters of the broad Hamilton River. Lake Melville is a large fjord about 100 miles long that extends between 53° 20′ and 54° 00′ north, and between 58° and 60° west. Goose Bay airport is situated on an extremely level sandy terrace which is about 100 feet above the level of Lake Melville and which forms a promontory bounded on the north by Goose Bay and Terrington Basin and on the south by the Hamilton River.

The Hamilton River (Figure 1) from below Muskrat Falls to Charles Point where it enters Lake Melville, flows swiftly through sand deposits. Erosion of the banks is continuous and there are numerous sand bars and islands in the river which constantly change their shape and position. The smaller Goose River flows through sand also in its lower reaches but through clays and igneous outcrops further upstream. This is also true for the meandering Traverspine River which enters the Hamilton from the south. The Traverspine River clays which are of a very fine texture contain numerous concretions.

The Hamilton flood-plain below the terrace is criss-crossed with many ox-bows of the river and there are numerous pools and bogs. The country between Northwest River and Goose Bay is covered by considerable expanses of floating bog and the winter road joining the two places is impassable in summer. These physical conditions, of course, add to the difficulty of effective botanical coverage of the region.

The surface waters of the western portion of Lake Melville are fresh no doubt due to the tremendous flow from the Hamilton. At Northwest River, a few miles northeast of Goose Bay, seaweeds are deposited on the sandy beach but the water tastes fresh.

The sand terrace on which the airport lies is covered by open parkland forest consisting chiefly of spruce with a shrub story of *Betula glandulosa*, *Ledum groenlandicum* and scattered *Kalmia angustifolia*. Ground cover is predominantly lichen but there is a great deal of blueberry and numerous patches of *Lycopodium* species. In contrast, the flood-plain of the river is covered by a dense boreal forest of spruce, extremely large balsam, birch and occasional poplar. Birch, poplar, willow and pin cherry quickly fill the natural or man-made clearings. In low wet ox-bows alder and willow predominate. The

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number of species found below the terrace is greater than the number directly upon it. Many springs emerge from the base of the terrace and the sheltered gullies formed by them harbour a rich flora.

In the Appendix to his paper, Kindle (1924) gave detailed meteorological observations for the period July 18 to Sept. 24, 1921. These observations were made at Carter Basin on the south shore of Lake Melville and provided a clear picture of the climate of the Melville area. During the summer of 1950 we obtained carbon copies of all the weather records kept throughout that summer. Since one of the world's chief transatlantic airports is located there, very complete weather data is recorded. The standard airways weather record gives observations on ceiling, sky conditions, visibility, relative humidity, pressure, temperature, dew-point, wind and cloud types. No purpose is served by reproducing this data here. However, a general statement on weather conditions during the year of our survey may be of interest.

During the latter part of April, 1950, the temperature dropped below freezing at night rising to about 50°F by noon, but at times the temperature scarcely rose above 45°F. Wet snow and freezing temperatures are the rule well into May. In fact, temperatures in the fifties were not experienced until mid-May and there was snow on May 18th. When I arrived on May 24th the high was 65°F by mid-afternoon. Snow was still abundant in the woods and the willows and alders were just coming into flower. Violets were out by May 27th and willows were in full flower but by then temperatures were close to 80°F maximum. By early June temperatures had risen into the eighties with lows in the fifties at night. July and August were slightly higher, a maximum of 89°F being enjoyed on August 9th. During the last week of August there was a noticeable decline in temperature.

A number of lists of Labrador plant species have been published. A few of them enumerated the species of the Lake Melville area but only one (Porsild, 1944) specifically referred to Goose Bay. There is an historical reason for lack of emphasis on Goose. The settlement there, which is far larger than any other in Labrador, with the possible exception of the new iron development at Knob Lake, originated during World War II when the airport was built as an alternate to that at Gander, Newfoundland. Subsequently it has developed as a major international overseas airport.

One of the earliest botanical reports pertaining to the Goose Bay area was that of J. M. Macoun who made an enumeration of Labrador plants (1895). Macoun's species list was based on those previously published especially that of Packard (1891) and upon herbarium records. Of the four columns indicating localities in his species list, the second referred to "the basin of the upper Hamilton River." This column contains 145 species. Fernald and Sornborger (1899) listed many of the species of the 300 collections made by the 1891 Bowdoin College Expedition for the rediscovery of the Hamilton or Grand River Falls and also those of the Sornborger collections made along the coast of Labrador.

The best enumeration of Labrador plant species was that of Wetmore (1923) but only a small percentage were from the west end of Lake Melville. Kindle (1924) repeated Wetmore's checklist of plants in his analysis of the

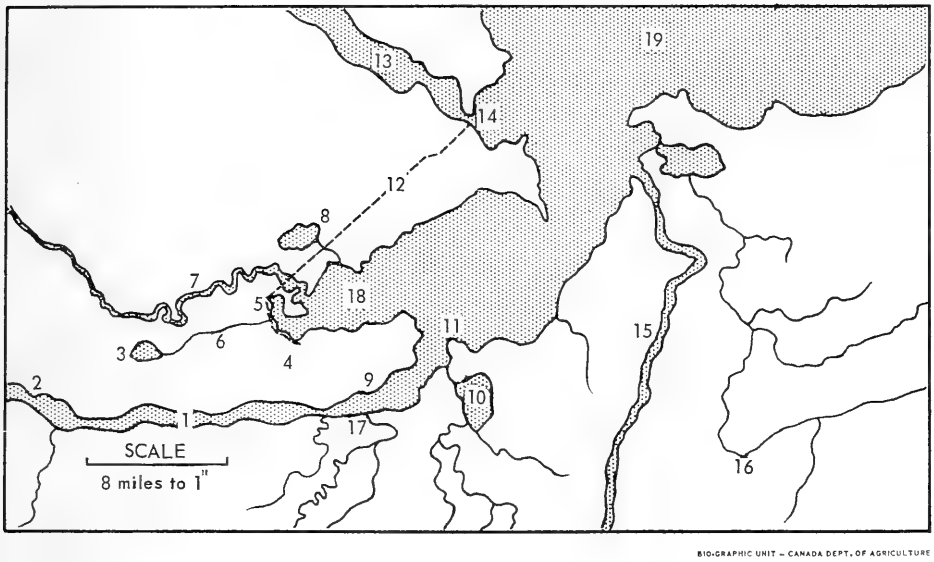


FIGURE 1. Map of Goose Bay area showing major features.

1. Hamilton River
2. Muskrat Falls
3. Alexander Lake
4. Airport
5. Terrington Basin
6. Otter Creek
7. Goose River
8. Potato Lake (my name)
9. Happy Valley
10. Mud Lake
11. Charles Point
12. Winter Road
13. Grand Lake
14. Northwest River
15. Kenamu River
16. Kenemich River
17. Traverspine River
18. Goose Bay
19. Lake Melville

flora. However, this analysis was severely criticized by Fernald (1926) in a paper presenting botanical evidence bearing on the boundary dispute between Canada and Newfoundland. Hustich and Pettersson (1944) listed species from Northwest River, the closest point to Goose Bay. The most recent list is that of Doutt (1955) who was botanist to the Carnegie Museum Expedition of 1939. The members of this expedition journeyed by canoe up the Hamilton as far as the Lake Plateau region of the upper river. A total of 340 species were included in Doutt's enumeration, this number representing her transect collections across the entire length of the Hamilton valley plus the species reported by Wetmore (1923), Hustich and Pattersson (1944) and Abbe (1936). No mention was made of Porsild's (1944) paper listing the species seen by him at Goose Bay in October, 1943. At this time the plants were frozen and Porsild collected specimens of "critical" items only.

The collection method of the Carnegie Expedition was of a transect nature, traversing the whole of Labrador from east to west by way of the Hamilton River valley over a period of about six weeks (from early July until mid-August). In contrast the author and Mr. W. I. Findlay collected primarily at Goose Bay for a period of approximately three months, from May 24th until

September 6, 1950, and therefore obtained full seasonal coverage of the flora at that point. We lived at the Royal Canadian Air Force Station and worked together in cooperation with a group of entomologists and their summer assistants. The project was financially supported by the Defence Research Board, Department of National Defence. Throughout the course of the season we travelled by jeep or truck along the various airport roads, by outboard motor boat along the shores of the bays and rivers and on foot across country where no roads existed.

By these methods we "covered" the shores of Goose Bay and Terrington Basin on Lake Melville and the Hamilton River shores and islands as far as Muskrat Falls. From the south shore of the Hamilton River we ventured into Mud Lake and ascended the Traverspine River as far as the first rapids. We achieved (by arrangement, invitation and persuasion) an afternoon at Northwest River by R.C.A.F. powerboat, a Norseman flight to Grand Lake, a Norseman flight to the Mealy Mountains for three days (Gillett, 1954), a flight by Dakota to Fort Chimo and two flights by Dakota to Mingan, Quebec on the north shore of the St. Lawrence.

As a result of the summer's work, approximately twelve hundred collections of vascular plants with extremely large numbers of duplicates useful to our expanding exchange program were made. Some mosses, lichens and fungi in limited quantity were gathered also. These collections include 34 species of bryophytes and 297 of higher plants. Of the higher plants 56 are additions to the native flora of western Lake Melville and 22 are additional adventives. Because of increasing interest in the flora of Labrador, it is considered desirable to record this collection. The lichens and fungi are not reported.

In the annotated list which follows, the collections made by Judd, Montgomery, Sharpe, Schofield, Beckel and Senn, deposited in the Plant Research Institute herbarium are also reported for the first time. Included under my collection numbers are the collections of Mr. I. A. McKay from the Kenamu and Kenemish Rivers, an area which neither I nor Mr. Findlay personally visited. Dr. W. W. Judd, an entomologist, now at the University of Western Ontario, made a few collections in 1948; Miss Montgomery collected during the stopover at Goose Bay while waiting for connecting aircraft to continue her journey northward. Sharpe was, I believe, an assistant to the entomologists at Goose Bay during 1948. W. B. Schofield, then a summer assistant at our laboratory, collected at Goose Bay in 1949 on his way north to Cornwallis Island and again on his way back later in the same year. Although Schofield was more interested in mosses than in phanerogams, he did obtain a good collection of higher plants during the period June 4 to 14th and August 9 to 16, 1949. William Beckel was an assistant entomologist stationed at Goose Bay during 1948. Dr. H. A. Senn, formerly Director of this Institute, made a small collection in 1948 during a stop-over on his way to Fort Chimo and Frobisher Bay. The writer made an additional twenty-five collections in 1954 during a similar stopover on the way to Saglek, Labrador (Gillett, 1960).

## ANNOTATED LIST OF SPECIES

The arrangement of the bryophytes is alphabetical under the headings Musci and Hepaticae. These were all identified by Dr. W. C. Steere. The higher plants follow the same sequence as in Doutt's list which is the sequence of Fernald (1950) so that they are comparable. *Carex* species were mainly identified by Mr. J. A. Calder of this Institute but a small number were examined by E. Lepage of Rimouski, Quebec. Collection numbers following the remarks are those of the writer unless otherwise stated. An asterisk preceding a species entry indicates an addition to Doutt's list, two asterisks indicate that the species was reported by Porsild (1944) and not by Doutt (1955). All specimens are in the herbarium of the Plant Research Institute and duplicates have all been widely distributed.

### MUSCI

*Atrichum crispum* (James) Sull. On ground along road to Alexander Lake. Spores shedding, June 21, *5084.*

*Aulacomnium palustre* (Weber) Schwar. Along creek bottom. Common, *4923, 5854.*

*Blasia pusilla* L. Along the Hamilton River, *5638.*

*Barchythecium salebrosum* (W. & M.) BSG. Woods at Mud Lake; woods along stream near the pumping station, *5435, 5558.*

*Ceratodon purpureus* (H.) Brid. Along Goose River. Common everywhere, *5019, 5389, 5919.*

*Climacium dendroideum* (H.) Web. Under alders, *4919.*

*Dicranella cerviculata* (H.) Schp. On earth along banks of a small stream, *4773.*

*Dicranum fuscescens* Turn. On stumps and hummocks; common, *4774, 4798, 4839, 5606;* along the Kenamu River, *5834.*

*Ditrichum pusillum* (H.) E. G. Britton On soil, Charles Point, *5922.*

*Drepanocladus fluitans* (H.) Warnst. Abandoned farm area, *5719.*

*D. uncinatus* (H.) Warnst. On log, *5377, 5918.*

*Fontinalis antipyretica* H. Flowing streams, attached to sticks, *4832, 5899.*

*Funaria hygrometrica* H. Sandy soil everywhere, *5587, 5725.*

*Grimmia alpicola* var. *rivularis* (Brid.) Broth. Along the Traverspine River, *5605.*

*Hygrohypnum alpestre* (H.) Loeske Along a stream, *5553.*

*Hylocomium splendens* (H.) BSG. Sandy slope, *5059;* Grand Lake, *5857.*

*H. umbratum* (H.) BSG. Base of the sandy plateau bank, *5061.*

*Hypnum crista-castrensis* Hedw. In deep spruce-fir woods near Alexander Lake, *4783;* along the Kenamu, *5810;* Senn *3402.*

*Mnium affine* Bland. On earth, *5379, 5546.*

*M. cinclidioides* Huben Marshes, *4833;* along the Kenamu, *5829.*

*Mnium punctatum* L. var. *elatum* Schimp. Near pump station, *5684.*

*Philonotis fontana* (H.) Brid. Along bank of stream, *5545.*

*Plagiothecium denticulatum* (H.) BSG. *5685.*

*Pleurozium schreberi* (Brid.) Mitt. Sandy slopes and spruce-balsam forest, *4779, 4923, 5887;* Senn, *3335, 3346.*

*Pohlia nutans* (H.) Lindb. On earth, *5031, 5375, 5378, 5901.*

*Polytrichum commune* Hedw. Sterile, abundant along pool margin, *4787, 5920.*

*P. gracile* Sm. Border of stream, *5559.*

*P. juniperinum* Hedw. Antheridial stage, abundant on sandy trail, *4785, 5027, Senn 3365, 3380A* admixed with *P. commune.*

*Tetraphis pellucida* H. Margin of stream, *5560.*

*Tetraplodon angustatus* (H.) BSG. On a stump, *5339, 5340.*

### HEPATICAE

*Lophozia alpestris* (Schleich) Evans, admixed with *Mylia anomala, Senn 3401.*

*Marchantia polymorpha* L. Edge of streams, *4936, 5557, Senn 3347.*

*Mylia taylori* (Hook.) S. F. Gray, *Senn 3399.*

*Ptilidium pulcherrimum* (Web.) Hpe. On fallen birch trunk, *5106.*

PTERIDOPHYTA

*Equisetum arvense* L. Common to abundant along undisturbed sandy roads. One collection may be considered as forma *ramulosum* (Kupr.) Klinge, abundant on sandy slopes at edge of bog, *5225;* two collections, *5093, 5544* are var. *boreale* (Bong.) Rupr. and one, *5885*, would further segregate into f. *pseudonemorosum* Boivin. The number of forms described for this species is becoming ridiculous and a complete reassessment of their worth is required.

*E. fluviatile* L. Forming solid stands on open wet sand along a stream, *5097*.

*E. palustre* L. Sandy slopes and in wooded areas, *5226*.

*E. sylvaticum* L. f. *multiramosum* Fern. Sandy roadsides and in sand exposed by digging, *4806, 5214, Judd 22, Senn 3325*.

*Lycopodium annotinum* L. Sparse to abundant in forest clearings; on the island at Happy Valley; near the Kenamu River, *4866, 5842, Schofield 756;* var. *pungens* (La Pylaie) Desv. *4799*.

*L. clavatum* L. var. *megastachyon* Fern. & *Bissell* On sandy forest floor; south shore of Hamilton River; Fox Bluff, an island on the south shore, *5145, 5712, Schofield 673*.

The material of *L. clavatum* should properly be referred to var. *megastachyon* for both the peduncles and strobili tend to be long and only one strobilus is borne on each pedicel. Material of var. *clavatum* tends to have two or more borne on slender peduncles. European material appears to have sessile strobili. However, these conditions are tendencies only because selected plants may have both sessile and stalked strobili.

*L. inundatum* L. Locally abundant in muddy parts of bog near Alexander Lake, *Schofield 823*.

*L. obscurum* L. Steep northeast-facing sand slopes, spruce-lichen-Ledum barrens and open places in spruce forest; on both sides of the Hamilton River and on the Kenemich River, *4778, 5771, 5813, Schofield 803*.

*L. sabinaefolium* Willd. var. *sitchense* (Rupr.) Fern. Lichen-spruce forest over sand, shallow-rooted in lichen mat, *4860, 8478*.

*L. selago* L. Alder-willow scrub above beach, Terrington Basin, *5792*.

**L. tristachyum* Pursh Sandy spruce-lichen bench, Charles Point, *4859, 5150*.

*Selaginella selaginoides* (L.) Link Alder-willow scrub above tidal beach, widely scattered but common. Also in wet sphagnous bog, Terrington Basin, Alexander Lake, *5793; Schofield 822*.

*Botrychium lunaria* (L.) Sw. Wet, spring-fed ravine, heavily wooded, rare, June 12. *4942*.

**B. multifidum* (Gmelin) Rupr. var *intermedium* (D. C. Eaton) Farw. Rare in sandy soil of woods bordering the Hamilton River, August 15, *Schofield 802*.

*Onoclea sensibilis* L. Island in the Hamilton River in dense alder scrub. Rare. The vicinity was thoroughly searched for material with fertile fronds but none were found probably because of the lateness of the season. Not seen elsewhere in the district, *5689*.

*Dryopteris disjuncta* (Rupr.) Morton Wet sheltered ravines. Abundant also in slash of logged forest, *5337, 5505*.

*D. phegopteris* (L.) C. Christens. Abundant in sphagnous patches in dense spruce-balsam-birch forest along Alexander Lake road, *5361*.

*D. spinulosa* (O. F. Muell.) Watt In dense spruce forest and under alders. Islands and shores of the Hamilton River and Kenamu River, *5679, 5688*. var. *americana* (Fisch.) Fern. Mud Lake, *5149, 5434, 5548, 5815*.

*Athyrium filix-femina* (L.) Roth var. *michauxii* (Spreng.) Farw. Along a stream, common. *5115*. One collection, *5380*, may be referred to f. *rubellum* (Gilbert) Farw.

GYMNOSPERMAE

*Abies balsamea* (L.) Mill. A chief component of the forest, becoming 50 ft. high and 6 in. in diameter, *4893, 5419; Senn 3405*.

*Picea glauca* (Moench) Voss Scattered large trees in lowland but not seen on the sand terrace, *4869, 5804*.

*P. mariana* (Mill.) BSP. Predominant conifer in the region, forming low forest, *4838, 5805, 5855, Senn 3363, 3351, Montgomery s.n.* Northwest River.

*Larix laricina* (Du Roi) Koch Common throughout the area in several habitats, *4803, 5633, Senn 3364*.

*Juniperus communis* L. var. *depressa* Pursh In deep sphagnum in a bog near

the Alexander Lake road at the base of the hills, *8490, 5090, Schofield 829, Senn 3406, Judd 50.* Northwest River, upper beach, *5511.* Fernald (1926) stated that this species was var. *montana* Ait.

MONOCOTYLEDONAE

*Sparganium angustifolium* Michx. In sloughs and shallow water of slow streams. Seen in the Goose River, *5381, 5390, 5632, 5764, 5803.*

**S. minimum* (Hartm) Fries In shallow ponds, *5392, 5400.*

**Potamogeton epihydrus* Raf. var. *nuttallii* (C. & S.) Fern. Streaming with current in 3-4 ft. water, *5909.*

**P. foliosus* Raf. var. *macellus* Fern. Streaming with current, Hamilton River at Charles Point, *5910.*

*P. gramineus* L. Goose and Hamilton Rivers, *5455, 5757;* var. *maximum* Morong, Hamilton River, *Schofield 806.*

**P. nodosus* Poir. Bog below the terrace, *5861.*

*P. richardsonii* (Bennett) Rydb. In shallow water, widely scattered, sand bottom, Terrington Basin; common at Charles Point. *5765, 5902.*

*Triglochin maritima* L. Wet gravel, stream and marsh margins. On the Northwest River winter road near Potato Lake. First seen in flower June 30, *4930, 5161, 5183.*

**T. palustris* L. Wet turf shore, Terrington Basin and muddy sand flats, Charles Point, *5648, 5912.*

*Scheuchzeria palustris* L. var. *americana* Fern. Bogs and muskeg, scattered but common, *5404, 5844, 5875,* Schofield *s.n.*

**Sagittaria cuneata* Sheldon. Common in a tidal bay, Terrington Basin. Exposed only at low (freshwater) tide, *5507A, 5761.*

*Glyceria borealis* (Nash) Batch. Marshes and shores bordering the Hamilton River. Deeply rooted in soft mud, *5693, 5721.*

*G. striata* (Lam.) Hitchc. In sawdust, former lumbering site, Goose River, *5385;* var. *stricta* (Scribn.) Fern. Terrington Basin, *5796.*

*Poa annua* L. Abundant in thick pasture sod, Mud Lake, *5151.*

**P. compressa,* L. Sandy banks and roadsides, scarce, *5573, 5771, 8493.*

*P. eminens* C. B. Presl A few scattered plants, sand shore of Terrington Basin, *5800.*

*P. palustris* L. Cultivated fields, Northwest River; clay gullies, Traverspine River; sand shores, Kenamu River, *5385, 5613, 5539, 5623, 5624, 5715, 5850.*

*P. pratensis* L. Sandy clearings and roadsides, *5159, 5586.*

**Agropyron pectiniforme* R. & S. Mouth of Terrington Basin, *5506.*

*A. repens* (L.) Beauv. Common in gardens, cultivated fields and along roadsides. The varieties and forms of this species are of questionable value, therefore I am disregarding them in this list. *5515, 5413A.*

**A. trachycaulum* (Link) Malte Again the varieties of this species need further study, most are merely forms. The species is common along roadsides, on shores of streams, *5431, 5497, 5472, 5773, 5799, 5614, Schofield 799.*

*Hordeum jubatum* L. Open sandy clearings, clay riverbanks, scarce, *5580, 5618, Schofield 755.*

*Elymus mollis* Trin. Sandy beaches along the Goose River on depositing bends. Also on shore at Northwest River, *5238, 5521, 5705, 5821.*

*Trisetum spicatum* (L.) Richter. Abundant in a sandy clearing near the Hamilton River, not seen elsewhere about Goose Bay but it was found at Northwest River, *5536, 5635.*

**Deschampsia caespitosa* (L.) Beauv. var. *littoralis* (Reut.) Richter Sandy beaches of Hamilton River, *5903, 5917.*

*Calamagrostis canadensis* (Michx.) Nutt. var. *robusta Vasey* Abundant along all rivershores, in sandy clearings and in ditches along roadsides, *5346, 5622, 5742, 5774, 5849.* Reported by Porsild (1944) under *C. Langsdorfii* (Michx.) Nutt.

*C. neglecta* (Ehrh.) Gaertn., Mey. & Schreb. Scarce above beach of Terrington Basin, *5926.*

*Agrostis scabra* Willd. Abundant in sandy clearings everywhere, *5578, 5703, 5728, 8597, Beckel 17, Schofield 679B;* var. *geminata* (Trin.) Swallen, similar habitats, *5334, 5745A, Schofield 699;* f. *exaristata* Fern., Grand Lake, *5745B;* var. *septentrionalis* Fern. Terrington Basin, *5785;* f. *setigera* Fern., Grand Lake, *5737.* I have no opinion on the status of these varieties and forms.

*A. tenuis* Sibth. *5458;* f. *aristata* (Parn.) Wieg. *5868.*

*Cinna latifolia* (Trev.) Griseb. Common, gravel roadsides, *5552, 5583, 5898, 8481.*

*Phleum pratense* L. Burnt over barrens, *5413, 5873.*

*Alopecurus aequalis* Sobol. Sandy clearings and muddy shores. Rare to occasional, *5717, Schofield 831.*

*Hierochloe odorata* (L.) Wahl. Stand at edge of gravel road, *4948.*

**Bromus catharticus* Wahl Scarce about an abandoned farm, *5718.*

**B. ciliatus* L. Sandy shore of Terrington Basin above tide level, *5802.*

**B. inermis* Leyss. Roadside in sandy soil, common, *5881, 5341.*

**Oryzopsis canadensis* (Poir.) Torr. Sandy roadsides and cuts through spruce forest, *5168, 8479.*

*Eleocharis acicularis* (L.) R. & S. Damp depressions in sand along the Goose and Hamilton Rivers, *5391, Schofield 680;* var. *submersa* (Hj. Nilss.) Svenson Shallow water, sandy mud bottom, common, *5915.*

*E. palustris* (L.) R. & S. Sandy flats and mucky shores of Goose Bay and Terring Basin. There is a dense stand on tidal flats at Charles Point, *5215, 5491, 5766, 5914.*

**E. pauciflora* (Lightf.) Link var. *fernaldii* Svenson Forming thick sod at shoreline of Terrington Basin, north end, immersed at high tide, *5490.*

**E. smallii* Britt. Swamp, abundant, *Schofield 772.*

*Scirpus atrocinctus* Fern. In open pools of water near the Goose River, and in wet clearings in sand, Terrington Basin, *5373, 5758.*

*S. caespitosus* L. var. *callosus* Bigel. Wet or floating sphagnous bogs, very common throughout, *4853, 4892, 5408, 5487, 5662, Judd 27, Senn 3358.*

**S. hudsonianus* (Michx.) Fern. Abundant in bogs, usually in a slightly dry microhabitat, *5029, 5062, 5167, 5476, 5500,* Beckel *s.n.*

*S. rubrotinctus* Fern. Marsh with sand bottom near the Goose River, *5219, 5444.*

*Eriophorum angustifolium* Honck. Wet ditches and marshes, fairly common, *4858, 4964, 5212, 5231* (later coll. of *4858*), *Schofield 775.*

*E. gracile* W. D. J. Koch Found only once in a floating bog on the winter road between Goose Bay and Northwest River, *4933.*

**E. russeolum* Fries Sandy soil, wet edge of swamps, in a ditch near Terrington Basin, *5096, 5241, 5649, Judd 41, Schofield 750.*

*E. scheuchzeri* Hoppe Wet muskeg over sand, *4848.*

*E. spissum* Fern. Open wet bogs and clearings, in clumps; fairly common, *4784, 4904, 5230, Judd 17, Senn 3382.*

**E. tenellum* Nutt. Deeply rooted in sphagnous bog, *5879.*

***E. virginicum* L. Bogs, particularly the one near Alexander Lake, *5467, 5657, 5880, Schofield 816.*

**E. vidiri-carinatum* (Engelm.) Fern. Wet bog over sand at the mouth of Terrington Basin; sphagnous bogs throughout the area, *4857, 5349, 5504, 5876.*

***Rhynchospora alba* (W.) Vahl Found in two bogs near Terrington Basin, abundant in one, *5465, 5661, Schofield 745.*

**Carex abdita* Bickn. Common in open sandy places on the terrace, *5021, 5780.*

*C. angustior* Mack. Common in sandy clearings and in bogs along the Goose River; dense alder-willow-sweet gale scrub above the beach of Terrington Basin, *5442, 5468, 5794A.*

*C. aquatilis* Wahlenb. Margins of sedge pools, *5692.*

**C. arcta* Boot Sandy margin of Hamilton River, *Schofield 676.*

**C. argyrantha* Tuckerm Dry sandy places, occasionally in drier parts of bogs, *5160, 5417, 5464, 5867.*

*C. brunnescens* (Pers.) Poir. Open or shady sandy clearings; pebble beach at Grand Lake, *5177, 5443, 5735, Schofield 689.*

*C. canescens* L. The most abundant sedge in the district; in a variety of habitats from sedge meadows to bogs and sandy roadsides *5174, 5350, 5370, 5451, 5665, 8598, Judd 32, 37.*

**C. crawfordii* Fern. Occasional and scattered about an abandoned lumber camp site, south bank of Hamilton River, *5698.*

*C. deflexa* Hornem. Open sandy clearings, in round bunch-type clumps scattered under *Amelanchier, 4850, 5507, 5386.*

*C. disperma* Dewey Dense woods in Sphagnum. Alexander Lake vicinity, *5360.*

*C. exilis* Dewey. Wet bogs near Alexander Lake, *5466, 8483, 8488.*

*C. lenticularis* Michx. Abundant in this area; shores of rivers, forest clearings. Usually in moist places or frequently inundated areas, *5095, 5153, 5429, 5687, 5734, Judd 35.*

*C. limosa* L. Common in wet bogs, *5403, 5449, 8486, Schofield 768.*

**C. michauxiana* Boeck. Common to abundant bordering pools in bogs, *5463, Schofield 825.*

**C. muricata* L. Clumps in water-fllled ditch, *Schofield 797.*

*C. oligosperma* Michx. Deeply rooted in bogs, *5405, 5450, 5658, 5669, 5872, 8489, Schofield 747.*

*C. pauciflora* Lightf. In dense patches along roadside through bog in the Alexander Lake area, *5462, 8482.*

*C. paupercula* Michx. Common in bogs, *5351, 5460, 5501.*

*C. projecta* Mack. Clearings, site of an abandoned farm, in clay, *5724.*

*C. rariflora* (Wahlenb.) Sm. Immature material, identity doubtful but I collected this in the nearby Mealy Mountains (Gillett, 1954), *Judd 26, 28.*

**C. recta* Boott Meadows and pools, common. Lepage identified these collections to this species, *5411, 5786, 5787, Schofield 773.*

*C. rostrata* Stokes Marshes, meadows and bogs throughout the region, *5220, 5502, 5418, 5888, 5907.*

*C. saxatilis* L. var. *aurea* Bailey *Schofield 827.*

**C. X saxenii* Raymond (*C. paleacea* Wahlenb. x *C. recta* Boott) Determined Lepage. Swamps, *5184, 5492, Schofield 748.*

*C. stipata* Muhl. Sedge marsh, *5217.*

**C. tenuiflora Wahlenb.* Alder-willow-sweet gale scrub along beach of Terrington Basin, *5794B.*

*C. trisperma* Dewey Bogs, *5354, 5666, Schofield 749.*

*C. vesicaria* L. Meadows and sandy clearings, *5152, 5628, 5726, 5730.*

*Calla palustris* L. Along streams in shallow water, in larch bogs, *5108, 5499, Schofield 813.*

**Eriocaulon septangulare* With. Fairly abundant, edge of a lowland floating bog, *5471, Schofield 783.*

*Juncus alpinus* Vill. Choking small streams flowing into Terrington Basin and occasional on muddy banks of the Hamilton, *5489, 5713A, 5767.*

*J. balticus* Vill. var. *littoralis* Engelm. Sandy beach at Northwest River and along the Hamilton, *5173, 5527, 5577, 5702.*

*J. brevicaudatus* (Engelm.) Fern. Common in wet lowland, wet sandy roadsides, *5575, Schofield 668.*

*J. filiformis* L. Wet sandy clearings, muddy borders of Hamilton River, *5028, 5457, 5576, 5585, 5697, Judd 36, Schofield 826.*

*J. stygius* L. var. *americanus* Buchenau Bog, in shallow water, *5401, Schofield 757.*

**J. tenuis* Willd. Gravel clearing, Otter Creek, *5775.*

**J. vaseyi* Engelm. Eastern range extension, low damp sandy ground along roadside, fairly common, *5574.*

**Luzula multiflora* (Retz.) Lejeune Apparently rare. Exposed sand, built-up area, *5474.*

*L. parviflora* (Ehrh.) Desv. Spring-fed ravines, base of terrace, Goose area; thickets on pebble beach, sparse, Grand Lake, *4940, 5738, Schofield 742.*

**Allium schoenoprasum* L. In a meadow at the mouth of the Traverspine River, only one plant collected, *5358.*

*Clintonia borealis* (Ait.) Raf. Sheltered ravines at the base of the terrace; rich damp woods and slopes along the Kenamu River, *5085, 5397, 5676, 5838, Judd 5, Schofield 740.*

*Smilacina trifolia* (L.) Desf. Abundant in wet bogs throughout the area, *4891, 4953, 5394, 5589, 5671, Judd 45.*

*Maianthemum canadense* Desf. Moist forest floors and sandy open places, common; along the Kenamu on high sandy ground in forest, *5120, 5816, Judd 8.*

*Streptopus amplexifolius* (L.) DC. var. *americana Schultes* Rich mixed wooded slopes of the sandy terrace and in richer parts of lowland about springs, *5098, 5509, Schofield 739.* First seen in flower June 23.

*Sisyrinchium montanum* Greene Blue-eyed grass was found only in a well-

established pasture at Mud Lake. It may be at Northwest River but no opportunity arose to examine this area carefully, *5222, 5433.*

*Iris versicolor* L. Lake shores, in swamps, and abundant along the margin of Terrington Basin, *5182, Beckel s.n.*

*Habenaria dilatata* (Pursh) Hook. Margins of pools and in wet ground, base of the terrace, *5125, 5478, 5612, Schofield 741.*

*H. hyperborea* (L.) R. Br. Beckel A-35.

*H. obtusata* (Pursh) Richards. Wooded slopes, muskeg and moist shaded woods bordering the Hamilton River, *4952, 5060, 5180, 5395, Schofield 804.*

*Spiranthes romanzoffiana* Cham. The most common orchid in the area particularly along the Northwest River winter road, *5347, 5651, 5691, Schofield 774, 836.*

*Goodyera repens* (L.) R. Br. var. *ophioides* Fern. This is very common in the shelter of dense spruce and mixed woods on both sides of the Hamilton River and far up the Traverspine River, *5592, 5611, 5637, Schofield 685.*

*Listera cordata* (L.) R. Br. Wet ravine, often on decayed logs, *4941.*

*L. auriculata* Wieg. Rare in shady soil near the Hamilton River. Originally this sheet was named *L. cordata* but C. Schweinfurth reidentified it as *L. auriculata* and stated that it was a new northern record. It is listed by Abbe however, *Schofield 809.*

*Corallorhiza trifida* Chatelain var. *verna* (Nutt.) Fern. Mossy shaded forest floor along the Goose River, *5132.*

**Calopogon pulchellus* (Salisb.) R. Br. In a lowland bog near edge of open water, sparse, *5399.*

**Malaxis unifolia* Michx. Widely scattered but common in a lowland bog, *5398, Schofield 819.*

DICOTYLEDONEAE

*Salix argyrocarpa* Anderss. Only along the Goose River on sandy shores, *4950, 5447, Schofield 792.*

*S. bebbiana* Sarg. Very common in swampy ground, *4842, 4847, 4880, 5102, Senn 3326, 3328, 3332, 3340.*

**S. cordata* Michx. Apparently restricted to the Hamilton River islands, *5032, 5141, 5142, 5639, 5704.*

*S. discolor* Muhl. The most common willow in the area and producing a confusion of forms, many collections, *4775, 4793* representative.

*S. humilis* Marsh. Sandy slopes and pool margins. Common but can be confused with the last species in early growth stages, *4802, 4808, 4809, 4844, 4862, 4886, 5015, 5782.*

**S. lucida* Muhl. Hamilton and Goose River shores and islands, *4864, 8492, Schofield 794;* var. *intonsa* Fern. *5143, 5144, 5438, 5636,* at Mud Lake and with var. *lucida.*

*S. myrtillifolia Anderss.* Sandy roadside, a poor specimen of doubtful identity, *Senn 3381.*

*S. pedicellaris* Pursh var. *hypoglauca* Fern. Along the Hamilton River, and along the winter road to Northwest River in wet and floating bogs, *4802B, 4828, 4927, 5216, 5503.*

*S. planifolia* Pursh Everywhere throughout the region. I must confess that I misunderstood this species in the field and collected it repeatedly. Extreme variability probably accounted for this. Representative collections, *4830, Schofield 830.*

*S. pyrifolia* Anderss. Terrington Basin area, *4958, 5827* (Kenamu).

**S. serissima* (Bailey) Fern. Roadsides and clearings, Hamilton River, *4861, 4912, 4913.*

*Populus balsamifera* L. Forming large groves along the Goose River, *4934, 4947, 5441, Schofield 791.*

*P. tremuloides* Michx. Along the road to Happy Valley with spruce dominant; occasional on the plateau; abundant near the Goose River, *4843, 4957, Schofield 798, Senn 3407.*

*Myrica gale* L. Margins of bogs and streams, islands in the Hamilton River and found by McKay along the Kenamu River. The sexes seem to be restricted to one area suggesting that the species forms clones propagating vegetatively. One bog may contain all female plants and another male, *4788, 4795, 4818, 5124,* etc., *Judd 40, Senn 3386.*

*Betula borealis* Spach Sandy banks along the edge of the plateau, *4837, 5228, Senn 3355, 3362.*

*B. glandulosa* Michx. Dominant shrub cover on the terrace, *4811, Judd 24, Schofield 732, Senn 3342, 3343.*

*B. michauxii* Spach From a bog near Alexander Lake and from another in lowland near Terrington Basin, *5590, 8484, Judd 18, Schofield 743, 29.*

*B. papyrifera* Marsh. Common forest tree, *4805, 4909, 5870, Schofield 776;* var. *cordifolia* (Regel) Fern., border of Grand Lake and near Alexander Lake, *4797, 4836, 4909, 5227, 5232, 5668, 5736, Judd 19.*

**B. pumila* L. Lowland bogs, spruce forest; abundant and resembling *B. glandulosa* but the catkins are larger, *4910, 4871, Schofield 765.*

*Alnus crispa* (Ait.) Pursh var. *mollis* Fern. This species occurs in many habitats and is particularly abundant in clearings in spruce forest where it is a first succession plant. Along Grand Lake it forms a bank below the spruce at the top of the pebble beach, *4789, 4804, 4894, 5420,* etc., *Judd 16.*

*A. rugosa* (Du Roe) Spreng. var. *americana* (Regel) Fern. The two species grow intermixed in clearings but can easily be distinguished by the bud characters and there is a difference in the branch pattern. Clearings and bogs are the two most important habitats, *4777, 5496* (same plant), *Schofield 781, Senn 3357, 3359.* Reported by Porsild as *A. incana* (L.) Moench.

*Geocaulon lividum* (Richards.) Fern. Very common along the margin of the terrace in sand; in forest along the Kenamu, *4885, 4954, 5116, 5841, 5896A.*

*Rumex acetosella* L. Common weed of gardens and waste ground throughout the area, *4878, 4918, 5136, 5229, 5514.*

*R. fenestratus* Greene Along a creek in the Goose area and at Northwest River along a fence row, *5343, 5522, 5772.*

*Polygonum aviculare* L. Common weed of gardens, fields and open places about Goose Bay and Northwest River, *5537, 5566, Schofield 690, Sharpe 6.*

**P. convolvulus* L. Abundant about the R.C.A.F. station, *5581, Schofield 784.*

**P persicaria* L. Common on sandy roadsides, *5882.*

**P. scabrum* Moench Scarce in a sandy clearing, station area, *5778.*

*P. viviparum* L. Alder-willow-sweet gale scrub, Terrington Basin, *5795.*

*Chenopodium album* L. Waste places, *5565, Sharpe 8.*

**C. glaucum* L. Common about buildings, *5777, Sharpe 7,* determinations of *Chenopodium species* by H. A. Wahl, Pennsylvania State College.

**Urtica gracilis* Ait. Sandy riverbanks along the Traverspine River, not seen elsewhere, *5164, 5608.*

*Arenaria lateriflora* L. Northwest River, sandy beach above tidemark, and along the Kenamu, *5516, 5798, 5818.*

*A. peploides* L. On the beach at Northwest River and along the Hamilton near the mouth of the Kenamu, *5510, 5817.*

*Gypsophila elegans Bieb.* Beside a lawn in front of an R.C.A.F. residence, probably planted, *5335.*

*Stellaria calycantha* (Ledeb.) Bong. Northwest River, *5121, 5235, 5513, 5554.*

*S. crassifolia* Ehrh. Margin of creek, *5240, 5342.*

*S. media* (L.) Cyrill. Northwest River, *5535.*

*Lychnis alpina* L. var. *americana* Fern. Sandy banks and riversides, sparse, *5170, Schofield 683.*

*Nuphar variegatum* Engelm. Common at margins of bog pools in rather deep water, *5126, 5473, Schofield 764.*

*Ranunculus abortivus* L. var. *acrolasius* Fern. On rich soils of clearings along both the Hamilton and Goose Rivers, *4917, 5094, 5133.*

*R. acris* L. Gardens at Northwest River and at the mouth of the Traverspine, *5137, 5357, 5534, 5710.*

*R. hyperboreus* Rottb. Mud along a brook near the Goose River, *5239, 5345, 5753.*

*R. lapponicus* L. Rare, in a patch of woods along Terrington Basin, *4960, 5026, 5647, Schofield 667.*

*R. pensylvanicus* L. f. Along the Goose and Traverspine Rivers, *5387, 5600.*

*R. trichophyllus* Chaix. Otter Creek and Charles Point, *5851, 5908.*

*Coptis groenlandica* (Oeder) Fern. Very abundant in damp woods, *4937, 5383, Judd 13.*

*Actaea rubra* (Ait.) Willd. There was a small patch at Charles Point in white spruce-birch forest and it was found in forest along the Traverspine River, *5147, 5604;* f. *neglecta* (Gillman) Robinson, Hamilton and Goose Rivers in alder scrub, *5700, Schofield 814.*

*Thalictrum polygamum* Muhl. Meadows and marshes, *5211, 5356, 5409, Schofield 674;* var. *hebecarpus* Fern. Grand Lake and along the Kenamu, *5741, 5824.*

*Corydalis sempervirens* (L.) Pers. Sandy places, common, *5056, 5171, 5779, Judd* 38, Beckel 35.

*Subularia aquatica* L. Charles Point, sand flats in a few inches of water, temperature about 75°F, *5911.*

*Capsella bursa-pastoris* (L.) Medic. Cultivated fields in settled areas and sandy riverbanks of the Traverspine, *5367, 5517, Schofield 692.*

*Rorippa islandica* (Oeder) Borbas Cultivated field, Northwest River, and along the Goose River, *5446, 5526* var. *hispida* (Desv.) Britt. & Abbe, along the Goose River, *5755.*

*Cardamine pratensis* L. var. *palustris* Wimm. & Grab. Boggy stream, *5118.*

**Lepidium densiflorum* Schrad. Abundant throughout the area, *5055, 5883.*

**Brassica kaber* (DC.) L. C. Wheeler var. *pinnatifida* (Stokes) L. C. Wheeler, Lawn of R.C.A.F. Administration Building, *5210,* abandoned farm near the Hamilton River, *5716A.*

**B. rapa* L. Abandoned farm, *5716.*

*Sarracenia purpurea* L. Most bogs, *4821, 5123,* in flower June 26.

*Drosera anglica* Huds. Muddy peat of quaking bogs, rather abundant in the Alexander Lake area, *5063, 5652, 8485, Schofield 785.*

*D. rotundifolia* L. Common in most bogs, *4849, 5674, 5797.*

*Mitella nuda* L. Rich ravines and spring-fed gullies, *4939, 5549, 5683.*

*Ribes lacustre* (Pers.) Poir. One station in a deep spring-fed sheltered ravine, fairly abundant there, *4935, 5555.*

*R. glandulosum* Grauer Profuse in every clearing, *4852, 4916, 5114, 5412, 5825, Judd 15, Montgomery s.n., Senn 3337.*

*Pyrus decora* (Sarg.) Hyland Scattered throughout the forests, *5087, 5166, 5754, 5835.*

*Amelanchier bartramiana* (Tausch) Roem. The only species of juneberry in the region, forming groves on east-facing sandy slopes of the terrace and in the immediate lowland below, sometimes mixed with alders and willows, *4855, 4879, 5495, Judd 20, Senn 3356.*

*Potentilla egederi* Wormsk. var. *groenlandica* (Tratt.) Polunin Northwest River only, along the beach, *5532.*

*P. norvegica* L. Abundant in clearings along the Hamilton and at Northwest River, *5176, 5421, 5533, 5631.*

*P. palustris* (L.) Scop. Abuandant along Terrington Basin, *5221, 5788.*

*P. tridentata* Ait. [1]Common in patches in woods on the terrace and along sandy roadsides; on rock outcrops at Muskrat Falls, *5110, 5169, 8477, Schofield 677.*

*Geum macrophyllum* Willd. Sandy riverbank, Traverspine River, *5163, 5609.*

*Rubus chamaemorus* L. Swamps, bogs and roadsides, margins of woods, abundant throughout the region, *4846, 5185, 5542, 5839, Judd 23, Senn 3330, 3383, Sharpe 2.*

*R. pubescens* Raf. Very common in the region, mixed forest, alder-spruce or alder-willow swamps, pebble beaches, *4867, 4959, 5099, 5564, 5751,* both white and pink flowered forms occur within the same clone and even on the same inflorescence so that it is probably a character of aging. One collection bore the rust, *Gymnoconia peckiana* (Howe) Trotter, *4915* (determined J. A. Parmalee).

*R. acaulis* Michx. Clearing along Terrington Basin behind the sweet gale zone, common, *4956.*

*R. idaeus* L. var. *canadensis* Richards. *Beckel A65;* var. *strigosus* (Michx.) Maxim. Common along roadsides, *5155, 5414, 5571.*

*Prunus pensylvanica* L. f. A first succession tree in sandy clearings, everywhere abundant, *4888, 5416, 5655, 5852, Sharpe 3, Judd 11.*

*Sanguisorba canadensis* L. Margins of bogs near spruce forest. Seen at Muskrat Falls and at Grand Lake, *5113, 5656, 5739.*

*Trifolium pratense* L. Northwest River, Hamilton River shores, *5529, 5710A.*

**T. hybridum* L. Roadsides, Northwest River, *5156, 5530.*

**Melilotus alba* Desr. Sandy soil, abundant in one locale only, *5368.*

*Vicia cracca* L. In a chicken run at the settlement at the mouth of the Traverspine River, at Mud Lake, along the Hamilton, *5138, 5432, 5727.*

*Lathyrus japonicus* Willd. var. *glaber* (Ser.) Fern. Sandy beaches, Terrington Basin, Northwest River and the mouth of the Kenamu, *5477, 5512, 5791, 5822.*

*Geranium pratense* L. Northwest River, *5528.*

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[1]*P. fruticosa* L. was reported by Porsild as "common." I did not come across this shrub at any time. Certainly an error.

*Callitriche palustris* L. Occasional in quiet backwaters, Hamilton River, *5456, 5706.*

*Empetrum nigrum* L. Sphagnum bogs, *4972, 4819, 5042, Judd 6, Montgomery s.n.*

**Hudsonia tomentosa* Nutt. Sandy open spruce barren, scarce, *5233.*

*Viola pallens* (Banks) Brainerd Low marshy ground and stream banks, *4899, 4938, 5384, 5748, Judd 31;* a mauve-flowered form was found along the Goose River, *5134.*

**V. renifolia* Gray Roadside in sand, near the Hamilton River, *4791, Schofield 36;* var. *brainerdii* (Greene) Fern, on the island, Happy Valley, in dense spruce-birch-balsam forest and admixed with var. *renifolia, 4868.*

*Epilobium angustifolium* L. There are numerous forms on the terrace white-flowered, pink-flowered, narrow-leaved and numerous minor variants, *5158, 5410* (pink-flowered), *5770, 5892, Beckel A64, Schofield 730, Sharpe 10,* f. *albiflorum* (Dumort.) Haussk., *5353, Schofield 731;* var. *intermedium* (Wormsk.) Fern., *5234.*

*E. glandulosum* Lehm. var *adenocaulon* (Haussk.) Fern. Common in moist places, *5218, 5348A, 5415, 5550, 5768, 8480.*

**E. hornemanii* Reichenb. Abundant along a stream in a ravine, *5057, 5128.*

*E. latifolium* L. Along the Goose River, *5445, Schofield 795.*

**E. leptophyllum* Raf. Terrington Basin and along the winter road, *5348, 5498, 5644, 8491, 8494.*

*E. palustre* L. Terrington Basin, abundant in wet depressions of lowland, *5645, Schofield 738.*

**Myriophyllum exalbescens* Fern. River delta, Terrington Basin, *5807.*

*Hippuris vulgaris* L. Pools, *5430.*

*Aralia hispida* Vent. Very common on the sand terrace, *5338, 5475, 5891.*

**Cicuta bulbifera* L. Terrington Basin, *5650, 5763.*

**Daucus carota* L. One plant seen near a building, *5783.*

**Angelica lucida* L. Cultivated field. Northwest River, *5520.*

*Ligusticum scothicum* L. Goose Bay and on the Kenamu, *5801, 5848.*

*Heracleum maximum* Bartr.. Along the Goose, Kenamu and Traverspine Rivers, steep clay slopes, *5162, 5440, 5810.*

*Cornus canadensis* L. Common woodland species, *4884, 5181, 5682, 8491A, Beckel s.n., Judd 44.*

*C. stolonifera* Michx. A common shrub throughout the area, often mixed with *Viburnum, 5154, 5439, 5454, 5699, Beckel s.n.*

*Moneses uniflora* (L.) Gray Common on the forest floor throughout the region, *5119, 5213, 5396, 5836, Beckel s.n., Schofield 666,* collection *5119* infected with the rust *Chrysomyxa pyrolae* (DC.) Rostr.

**Monotropa uniflora* L. Abundant locally at margins of bogs, wooded slopes of the terrace and in alder scrub, *5469, 5667, 5897, Schofield 763.*

*Pyrola secunda* L. Abundant in spruce-balsam-birch woods, Terrington Basin and Traverspine River, *5372, Schofield 688.*

*P. minor* L. Similar habitats along the Goose River, Terrington Basin, and at Mud Lake, *5372A, 5436, Schofield 789.*

*P. chlorantha* Sw. Densely wooded river-banks along the Hamilton and Goose River, *5237, 5630, Schofield 805.*

*Ledum groenlandicum* Oeder In many habitats, moist sand, edge of bogs, dry sandy slopes, edge of forest, *4963, 5058, 5091, Judd 29.*

*Kalmia angustifolia* L. Common in most dry sandy open country, *5352, 5584, 5831, Beckel s.n., Judd 1.*

*K. polifolia* Wang. In both floating and solid bog, *4889, 4931, Judd 39.*

*Andromeda glaucophylla* Link Abundant in all sphagnous bogs, *4908, 4932, 5402, 5591, 5845, Judd 51, Schofield 754.*

*Chamaedaphne calyculata* (L.) Moench Edge of marshes, bogs, rivershores, spruce forest and in sandy soil, *4807, 4834, 5112, 5830, Judd 21, Senn 3331, 3387.*

*Gaultheria hispidula* (L.) Bigel. Very abundant in dense forest both sides of the Hamilton River, also on the Kenamu, *5107, 5708, 5847, Senn 3360.*

**Arctostaphylos uva-ursi* (L.) Spreng. var. *coactilis* Fern. & MacBride Common on spruce-lichen barrens on the plateau, *4962, Senn 3354.*

*Vaccinium angustifolium* Ait. Goose Bay terrace. The dominant blueberry in the region forming very large colonies. The berries are easily harvested because of the compact racemes but require considerable stooping because of their low

habit. I can vouch for their excellent cooking qualities because I brought a pail of them back to Ottawa for the purpose and astounded our Customs Officials at Dorval. There is considerable confusion with respect to the nomenclature of this species. I shall not employ *V. boreale* Aalders & Hall because I am not convinced that this is any more than a polyploid race. *4856, 4883, 4955, 5092, 5588, 5840, 5853, Judd 47.*

*V. vitis-idaea* L. var. *minus* Lodd. Very abundant on the plateau. Drier habitats in the lowland, *5157, 5481, 5509, 5826, Judd 7, Montgomery s.n., Schofield 665.*

*V. oxycoccus* L. Bogs in dense sphagnum, quite common, *5236, 5406, 5579, Beckel A4-5.*

**V. microcarpum* (Turcz.) Hooker Bogs, *Judd 2.*

**Lysimachia terrestris* (L.) B.S.P. Common along the Hamilton River. A large stand at the north end of Terrington Basin in the tidal zone did not produce flowers, *5627, 5729, 5784.*

*Trientalis borealis* Raf. Common in open gravel areas and on some damp wooded hillsides, *4896, Judd 12.*

*Menyanthes trifoliata* L. In most open wet bogs. This plant is a good indicator of open water to those who cross bogs on foot, *4890, 4911, 5117, 5407.*

**Myosotis sylvatica Hoffm.* In a garden at Northwest River, *5523.*

*Scutellaria galericulata* L. var. *epilobiifolia* (A. Ham.) Jordal Along the Hamilton and Traverspine Rivers, abundant, *5423, 5596.*

**Lycopus uniflorus* Michx. Very abundant in a sandy clearing near the Boat Club along the Hamilton River, also found on earth covering a water reservoir, *5427, 5572, Schofield 682.*

*Galeopsis tetrahit* L. var. *bifida* (Boenn.) Lej. & Court. Fence rows at Northwest River, settled areas along the Traverspine River, *5139, 5355, 5525, Schofield 684.*

*Mentha arvensis* L. f. *glabra* (Benth.) S. R. Stewart Sandy sedge meadow along the Hamilton River; wet steep clay riverbank, Traverspine River, *5615, 5714.*

*Veronica scutellata* L. Sandy field along the Hamilton River, *5175, 5422.*

**V. serpyllifolia* L. var. *nummularioides* Lec. & Lem. Common in very wet places, *5103, 5127, 5617.*

*Rhinanthus crista-galli* L. Not in the Goose vicinity but is at the mouth of the Kenamu on the south side of the Hamilton, *5812.*

**Utricularia cornuta* Michx. Abundant in several inches of water at the margins of bogs in the lowland below the plateau, *5540, 5653, Schofield 744.*

**U. intermedia* Haynes Common in pools in open sphagnous bogs. First seen in flower, June 26, *5122, 5663, 5862, 5874.*

**U. minor* L. Inconspicuous but abundant in lowland bog, *Schofield 788; 786* (as var. *americana* Gray).

*U. vulgaris* L. Pools in floating sphagnous bog, *5659, 5858.*

**Plantago major* L. Station area, *5759.*

*Galium triflorum* Michx. Wet wooded ravines, *5336, 5570.*

*G. trifidum* L. *Schofield 678, Beckel s.n.*

*G. labradoricum* Wieg. Common along streams, *5129, 5344, 5760.*

*Lonicera caerulea* L. var. *villosa* (Michx.) T. & G. Sphagnous bogs, particularly along the winter road to Northwest River, *4928; Judd 14.*

*Linnaea borealis* L. var. *americana* (Forbes) Rehd. Common in mixed forest from Muskrat Falls to the Kenamu, *5111, 5172, 5746, 5832, Beckel s.n.*

*Viburnum edule* (Michx.) Raf. A common shrub along the Goose River forming a shrub story with *Cornus stolonifera, 4914, 4946, 5109, 5453, 5675, Judd 42.* Reported by Porsild as *V. pauciflorum.*

*Solidago lepida* DC. Sandy clearings and roadsides, *5425, 5569, 5619, 5722, Beckel s.n.*

*S. macrophylla* Pursh Lake and rivershores, *5603, 5756, Beckel s.n.*

**S. uliginosa* Nutt. Alexander Lake bogs only, *5654.*

**Aster nemoralis* Ait. Scattered but abundant in wet sphagnum bog, many sterile plants, *5673, 5860, Schofield 817.*

*A. puniceus* L. In lowland, especially alder scrub, *5424, 5551, 5594, 5616, 5747, 5896, Schofield 762.*

*A. radula* Ait. var. *stricta* (Pursh) A. Gray Abundant in bogs, associated with *A. nemoralis, 5459, 5674A, 5859, Schofield 818.*

**A. johannensis* Fern. Terrington Basin, *5762.*

*Erigeron angulosus* Caudin var. *kamtschaticus* (DC.) Hara Clearing in forest, site

of lumber camp, shore of Hamilton River, *5696*.

*Anaphalis margaritacea* (L.) C. B. Clarke Sandy roadside, Hamilton River, *5426, 5568, 5607*.

*Achillea lanulosa* Nutt. Sandy places as dunes, rivershores, beaches, clearings and roadsides, *5366, 5709, 5811, 5820, Beckel 18, 35-238*. This is probably the same species that Doutt identified as *A. millefolium* L.

*Artemisia borealis* Pall. Island in the Hamilton River on sand dunes, this was the only patch seen. The plants were widely scattered, *5694*.

*Petasites palmatus* (Ait.) Gray Sandy rivershores, gravel roadsides, cut-over areas, *5030, 5086, 5131, Judd 48, Senn 3384, 3404*.

**Senecio vulgaris* L. Cultivated fields at Northwest River; cleared sandy places at Goose, *5518, 5543, Schofield 779*.

*Cirsium muticum* Michx. Common on a steep clay riverbank, Traverspine River, *5625*.

*Taraxacum sp.* Sandy shore of Goose River; settlement at Traverspine River. Specimens not sufficiently mature, *5135, 5140*.

*Leontodon autumnalis* L. var. *pratensis* (Link) W. D. J. Koch Lumbering site clearing, Mud Lake only, *5437*.

*Matricaria matricarioides* (Less.) Porter Weed of waste places and fence rows, *5538, 5567*.

**Chrysanthemum leucanthemum* L. Station area and mouth of the Traverspine River, *5359, 5365, 5776*.

**Cichorium intybus* L. Roadside, *5680*.

**Hieracium canadense* Michx. Abandoned farm clearings bordering Hamilton River, *5723, Schofield 808*.

**H. vulgatum* Fries Roadside near the Goose River; clay riverbank, Traverspine River, *5388, 5620*.

*Lactuca biennis* (Moench) Fern. Scarce in a clearing near Terrington Basin, *5769*.

*Sonchus asper* (L.) Hill Sandy clearing on station, one plant, obviously a weed, *5925*.

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# BIRD NOTES FROM LAC STE. ANNE, SAGUENAY COUNTY, QUEBEC

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## Introduction

From May 17 to September 30, 1959, the junior author resided at Lac Ste. Anne while carrying on fire protection duties. Much spare time was devoted to bird observation and collection. During that period, a total of 108 species were observed and 213 specimens representing 52 species were collected. Most of the time was spent around Lac St. Anne, but several trips were made to localities of the vicinity, including Godbout.

To our knowledge, the only literature pertaining to that general area are the numerous papers of N. A. Comeau and C. Hart Merriam which deal only with the coastal belt, and have been omitted from the text for that reason.

The specimens collected are preserved in the authors' collection.

## Geography

Lac Ste. Anne is located at approximately eighty miles north of Godbout, which is itself approximately 250 miles northeast of Quebec City. It flows into the Toulnustouc River which runs into the St. Lawrence River at Hauterive.

The topography of the area is moderately accidented. The highest peak of the area stands at 2140 feet. Lac Ste. Anne, which is one of the largest lakes of the area, is at an altitude of approximately 600 feet above sea-level. Rivers, lakes and ponds are very numerous and flow into the Toulnustouc River. Marshes and bogs, on the other hand, are scarce and of small size, as the land is heavily covered by forests. The few open areas occur where stands have recently been destroyed by fires.

The following list includes all the lakes mentioned in the text; all, except Lac Ben Louis and Lac Bellevue, are located between Lac Ste. Anne and Godbout:

Lac Hall, 65 miles north of Godbout
Lac Gros Morne, 60 miles north of Godbout
Lac de la Grande Baie, 50 miles north of Godbout
Lac Gédéon, 35 miles north of Godbout
Lac Gauthier, 12 miles north of Godbout
Lac Ben Louis, 186 miles north of Godbout
Lac Bellevue, 126 miles north of Godbout

## VEGETATION

The Lac Ste. Anne area falls well within the Laurentide-Onatchiway Section of the Boreal Forest, as defined by Rowe (1959). Coniferous stands are dominant covering about seventy per cent of the wooded area. Black spruce, *Picea mariana*, is the most common species; while white spruce, *Picea glauca*, and balsam fir, *Abies balsamea*, were encountered only occasionally. Tamarack, *Larix laricina*, is found only in wet places, usually near ponds and bogs.

Pure deciduous stands were not observed; however, successions were seen very frequently in areas which had been destroyed by forest fires at various times during the last twenty-five years. White birch, *Betula papyrifera*; yellow birch, *Betula lutea*; aspen, *Populus tremuloides*, and jack pine, *Pinus banksiana*, could be found in various proportions in such areas.

Alders, *Alnus* sp., and willows, *Salix* sp., are very common and form thick covers along the river banks and near the small ponds that abound in the lower places.

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## ANNOTATED LIST*

*Gavia immer* (Brünnich) COMMON LOON. Common. Seen almost daily from May 17 to October 1. The number of individuals seen varied from one to five. On August 31, an adult and two juveniles were observed swimming in shallow water. An adult male was collected on July 6.

*Podiceps auritus cornutus* Gmelin HORNED GREBE. Two adults with four juveniles were observed at length on August 7.

*Branta canadensis* (Linnaeus) CANADA GOOSE. Several observations were made in the spring, as follows: Lac Ste. Anne, May 17 (20), 22 (50), June 5 (18). Lac Hall, June 19 (1).

*Anas rubripes* Brewster BLACK DUCK. Uncommon summer resident: May 21 (24); June 19 (1); August 18 (4), 21 (1), 23 (2), 27 (4), 28 (2), 29 (12); and September 24 (3).

*Anas acuta* Linnaeus PINTAIL. A male and a female were observed on August 29.

*Anas carolinensis* Gmelin GREEN-WINGED TEAL. Two individuals, swimming in a pool near Lac Ste. Anne, were observed on May 19.

*Aythya marila nearctica* Stejneger GREATER SCAUP. Uncommon spring and fall migrant: Lac Ste. Anne, May 18 (2), 20 (2), 25 (8); September 6 (2). Lac Hall, a male, a female and a juvenile, July 23.

*Bucephala clangula americana* (Bonaparte) COMMON GOLDENEYE. Common in the area in the spring. Scarce during the summer: June 15 (1), 16 (1); July 15 (1), 18 (1); and August 27 (2).

*Bucephala albeola* (Linnaeus) BUFFLEHEAD. A single male observed for several hours on September 20.

*Mergus merganser americanus* Cassin COMMON MERGANSER. Observed along the streams and rivers of the area as follows: May 24 (2), 28 (2); June 2 (1); and July 13 (1).

*Mergus serrator serrator* Linneaus RED-BREASTED MERGANSER. Only one observation, on May 21, when three birds were seen on Lac Ste. Anne for the whole day.

*Accipiter gentilis atricapillus* (Wilson) GOSHAWK. Observed only in the early part of the summer: May 21 (1), 24 (1); and July 21 (1).

*All the observations were made at Lac Ste. Anne unless otherwise stated. A figure in parentheses following a date indicates the number of bird individuals seen on that date.

*Buteo jamaicensis borealis* (Gmelin) RED-TAILED HAWK. Rare summer resident. One individual was observed on the following occasions: July 9, and 23; September 10, 19, and 30. A juvenile male was collected on September 10.

*Buteo lineatus lineatus* (Gmelin) RED-SHOULDERED HAWK. Two were circling over a thick deciduous stand, at about 250 feet from the ground, on August 20.

*Buteo platypterus platypterus* (Vieillot) BROAD-WINGED HAWK. A single bird observed on August 3.

*Buteo lagopus s.johannis* (Gmelin) ROUGH-LEGGED HAWK. Observed only in the fall: Lac Ste. Anne, August 14 (1). Lac Hall, August 31 (1).

*Pandion haliaetus carolinensis* (Gmelin) OSPREY. The most common bird of prey of the area; it was observed daily from May 18 to October 1. The number of individuals varied from one to four.

*Falco peregrinus anatum* Bonaparte PEREGRINE FALCON. Single individuals were observed on a few occasions throughout the summer: Lac Ste. Anne, July 2, 12, 22, 23. Lac Hall, July 23. Lac de la Grande Baie, August 31 (2).

*Falco columbarius columbarius* Linnaeus PIGEON HAWK. Common summer resident. Observed almost daily from August 14 to September 30. Two specimens were collected: an adult female on August 14, and an adult male on September 4. The stomach of the specimen collected on September 4 contained the remains of a White-winged Crossbill (*Loxia leucoptera*) and two dragonflies.

*Falco sparverius sparverius* Linnaeus SPARROW HAWK. Observed on a few occasions, in open areas, where there were several dead trees: Lac Ste. Anne, August 3 (1) and 21 (1). Lac Gros Morne, August 31 (1). Lac Gédéon, August 31 (2). A juvenile male was taken at Lac Ste. Anne on August 3; its stomach contained about 150 ants.

*Canachites canadensis canace* (Linnaeus) SPRUCE GROUSE. Common breeder. Observed on several occasions at Lac Ste. Anne, Ben Louis and Bellevue. Two specimens were secured: a juvenile female on August 21, and an adult female on August 24. Notwithstanding the limitations of identifications based on single specimens, the adult female is referred to *canace* because of its measurements and its very reddish brown overall coloration. It also fits perfectly into the range of *canace* as delimited by Rand. The measurements (in mm) are as follows: wing, 157; tail, 100.5; exposed culmen, 13.5; tarsus, 35.5.

*Bonassa umbellus umbelloïdes* (Douglas) RUFFED GROUSE. An adult and four juveniles were observed on August 7 in a stand of deciduous trees.

*Charadrius semipalmatus* Bonaparte SEMIPALMATED PLOVER. A juvenile male was collected on August 27 from a flock of three feeding in a mud flat near the lake.

*Charadrius vociferus vociferus* Linnaeus KILLDEER. A single individual, perhaps the same one on both occasions, was observed and heard May 26 and June 3. It was feeding at the edge of the lake.

*Squatarola squatarola* (Linnaeus) BLACK-BELLIED PLOVER. Two birds observed and collected on September 24. They proved to be adults, male and female.

*Arenaria interpres morinella* (Linnaeus) RUDDY TURNSTONE. One individual was observed feeding on the shore of Lac Ste. Anne on June 8.

*Capella gallinago delicata* (Ord) COMMON SNIPE. Single individuals observed as follows: May 19 and 21; September 21 and 22. An adult male was collected on September 22.

*Actitis macularia* (Linnaeus) SPOTTED SANDPIPER. Common summer resident from May 22 to September 24. One nest containing four eggs was found on June 30. An adult with four downies was observed on July 13. On August 3, a female with four flightless young was observed. Several specimens were obtained.

*Tringa solitaria solitaria* Wilson SOLITARY SANDPIPER. Observed only during the fall migration: September 5 (1), 10 (2), and

12 (1). Two specimens were collected: an adult male on September 5, and a juvenile female on September 10.

*Totanus melanoleucus* (Gmelin) GREATER YELLOWLEGS. Rare migrant. The following observations were made: June 6 (1), August 11 (2), 12 (1), and September 20 (1).

*Erolia bairdii* (Coues) BAIRD'S SANDPIPER. An adult male was collected from a flock of Semipalmated and Least Sandpipers, on August 15.

*Erolia minutilla* (Vieillot) LEAST SANDPIPER. Fall and spring transient. Observed in small flocks from May 22 to 31, and from August 8 to 28. The flocks were much larger in August. A few specimens were collected.

*Ereunetes pusillus* (Linnaeus) SEMIPALMATED SANDPIPER. Observed during the fall migration only, from August 9 to September 5. The size of the flocks varied from 2 to 12 individuals. A few specimens were collected.

*Crocethia alba* (Pallas) SANDERLING. Seen only during the fall migration, on August 9 and 27. Three individuals were observed on each occasion.

*Larus marinus* Linnaeus GREAT BLACK-BACKED GULL. This very common species along the coast seldom ventures into the interior. It was observed only on June 1 at Lac Ste. Anne, when four individuals were circling the lake.

*Larus argentatus smithsonianus* Coues HERRING GULL. Very common in the area from May 17 to September 26. Most often seen feeding at the camp dumps and on dead fish. An adult female was collected on June 17; two immature males on August 22; an unsexed juvenile on September 16; and a juvenile female on September 26.

*Larus delawarensis* Ord RING-BILLED GULL. Observed only towards the latter part of the summer. One to five individuals were observed daily from August 15 to September 20.

*Zenaidura macroura carolinensis* (Linnaeus) MOURNING DOVE. A single bird was observed on August 31, at Lac Gauthier.

*Bubo virginianus* (Gmelin) GREAT HORNED OWL. Common resident. Observed regularly from May 23 to September 5. Near Lac Hall, two adults with four young were noted on August 6; four birds were seen in the same general area on September 5.

*Surnia ulula caparoch* (Müller) HAWK OWL. One individual was seen at Lac de la Grande Baie on October 1, in an open deciduous stand.

*Strix varia varia* Barton BARRED OWL. One bird was observed at Lac de la Grande Baie on August 6.

*Aegolius funereus richardsoni* (Bonaparte) BOREAL OWL. A single bird was seen on June 2, sitting at the top of a dry tree.

*Caprimulgus vociferus vociferus* Wilson WHIP-POOR-WILL. On July 8, a single individual was heard and seen. At Lac de la Grande Baie, another was heard and seen on July 23. They both were in a deciduous stand in a partly burnt-over area.

*Chordeiles minor minor* (Forster) COMMON NIGHTHAWK. Observed regularly in the area from June 18 to September 3. The number of individuals seen each time varied from one to four. Two birds were seen at Lac de la Grande Baie on July 23. A female adult was collected on September 3.

*Archilochus colubris* (Linnaeus) RUBY-THROATED HUMMINGBIRD. Two birds were seen on June 12, in a burnt-over area, where fireweed (*Epilobium angustifolium*) formed a good ground cover.

*Megaceryle alcyon alcyon* (Linnaeus) BELTED KINGFISHER. Very common summer resident. Observed from May 17 to September 19. A nest was found on June 27. It contained five eggs incubated by the male. On July 14, a male with six fledglings was observed. An adult male was collected on June 27.

*Colaptes auratus luteus* Bangs YELLOW-SHAFTED FLICKER. Uncommon summer resident. One to three individuals were observed regularly from May 18 to August 31. A female and two young were seen on July 10 and 11. An adult male was collected on July 30. It is in worn condition, and has the

following measurements: wing, 157.9 mm.; tail, 103 mm.; exposed culmen, 33.1 mm.; tarsus, 29.9 mm. These measurements are somewhat larger than those given by Ridgway for *luteus* and somewhat smaller than those of *borealis*. However, they do not differ significantly from those of a series from the Maritime Provinces and southern Quebec. This single specimen is, therefore, referable to *luteus*.

*Picoïdes arcticus* (Swainson) BLACK-BACKED THREE-TOED WOODPECKER. Uncommon resident. One to three individuals were observed on nine occasions from May 31 to October 1. Three adult males were collected: May 31, July 4, and July 21.

*Picoïdes tridactylus bacatus* Bangs NORTHERN THREE-TOED WOODPECKER. Uncommon resident. Observed as follows: May 24 (2), 31 (1); June 10 (2); and August 24 (2). The following specimens were taken: May 24, an adult female; May 31, an adult male; and August 24, an adult male.

*Empidonax flaviventris* (Baird and Baird) YELLOW-BELLIED FLYCATCHER. An adult male was collected on June 8.

*Empidonax traillii traillii* (Audubon) TRAILL'S FLYCATCHER. Single individuals heard and observed in alders and willows near the lake on June 11, 14, 19, and 20.

*Empidonax minimus* (Baird and Baird) LEAST FLYCATCHER. Rare. Seen on June 8 (2), July 3 (1) and September 23 (1).

*Nuttalornis borealis* (Swainson) OLIVE-SIDED FLYCATCHER. One was heard and seen in an open black spruce stand on June 1.

*Eremophila alpestris alpestris* (Linnaeus) HORNED LARK. Four birds were seen on an open sandy hill on September 30.

*Iridoprocne bicolor* (Vieillot) TREE SWALLOW. Common summer resident. Observed from May 20 to August 19. A nest containing six eggs was found between the walls of an abandoned building on July 23. A few specimens were collected.

*Riparia riparia riparia* (Linnaeus) BANK SWALLOW. Observed during the spring migration only, on the following dates: June 2 and 4 (2), June 3 (1).

*Hirundo rustica erythrogaster* Boddaert BARN SWALLOW. One adult male was collected on May 27. Another bird was observed on June 3.

*Perisoreus canadensis nigricapillus* Ridgway GRAY JAY. Very common resident. Observed in small flocks from May 17 to October 1. The first juveniles were observed on June 6. Several specimens were taken and are similar in size and color to series of specimens from Labrador, the North Shore of the Gulf of St. Lawrence and northern Quebec. They are, therefore, referable to *nigricapillus*.

*Cyanocitta cristata bromia* Oberholser BLUE JAY. A single individual was heard and seen in a deciduous stand, at Lac Gédéon, on October 1.

*Corvus corax principalis* Ridgway COMMON RAVEN. Single individuals regularly observed from June 2 to September 24. On July 22, an adult was observed feeding three juvenals. A juvenal male was collected on August 3, and an adult male on September 24.

*Corvus brachyrhynchos brachyrhynchos* Brehm COMMON CROW. Observed in small numbers from May 17 to September 10. A nest with four young almost fully feathered was found in a black spruce, *Picea mariana*, at about thirty feet from the ground, on June 27; two young were collected.

*Parus atricapillus atricapillus* Linnaeus BLACK-CAPPED CHICKADEE. Two birds were observed in a mixed stand on October 1, at Lac de la Grande Baie.

*Parus hudsonicus hudsonicus* Forster BOREAL CHICKADEE. Uncommon during the summer of 1959. On July 21, two adult birds and six fledglings were observed in a spruce stand. An adult male collected on September 20 has the following measurements (in mm): wing, 62.5; tail, 59.5; bill from nostril, 7; tarsus, 16.7. These measurements agree well with the measurements of *hudsonicus* as given by Godfrey (1951). Its back and pileum are quite grayish when compared with series from the Maritime Provinces. It agrees very well in coloration with specimens from the North Shore of the Gulf of St. Lawrence. It is, therefore, referred to *hudsonicus*.

*Sitta canadensis* Linnaeus RED-BREASTED NUTHATCH. Uncommon summer resident. Noted on July 13 (1), 27 (1); August 24 (10); September 1 (10), 9 (2), and 12 (2).

*Certhia familiaris americana* Bonaparte BROWN CREEPER. Four birds, probably a family group, were observed in a deciduous stand on July 19. An adult female with an incubation patch was collected.

*Troglodytes troglodytes hiemalis* Vieillot WINTER WREN. Common summer resident. Observed from May 17 to September 29. One nest containing five young was found under roots on the shoulder of a wood road on June 30. A few specimens were collected.

*Turdus migratorius migratorius* Linnaeus ROBIN. Common summer resident from May 18 to September 20. Its number decreased considerably after the first week of August. One nest was found on June 7; it contained 2 eggs and a young bird. Another was found on June 27 with three fledglings attended by both parents.

*Hylocichla guttata faxoni* Bangs and Penard HERMIT THRUSH. Observed only on June 9 (2), 10 (4), 13 (1), and 19 (3).

*Hylocichla ustulata swainsoni* (Tschudi) SWAINSON'S THRUSH. Common in the area from June 2 to July 21. The number of individuals observed daily varied from one to nine. Three adult individuals were collected. They are inseparable from specimens from the Maritime Provinces, Labrador, south and central Quebec, and are referred to *swainsoni*.

*Regulus satrapa satrapa* Lichtenstein GOLDEN-CROWNED KINGLET. Rare in the area. Single birds were observed on July 8 and 13.

*Regulus calendula calendula* (Linnaeus) RUBY-CROWNED KINGLET. Common summer resident. Observed from May 18 to September 23. Their number decreased considerably after July 15. Two adults and five fledglings were observed on July 15. An adult male was collected on July 4.

*Anthus spinoletta rubescens* (Tunstall) WATER PIPIT. Common spring and fall transient. Observed in considerable numbers on mud flats from May 20 to June 3, and September 2 to 30. Several specimens were obtained.

*Bombycilla cedrorum* Vieillot CEDAR WAXWING. Observed on June 13 (1) and 30 (2).

*Sturnus vulgaris vulgaris* Linnaeus STARLING. Common in the area from May 17 to July 8; not seen afterwards. Mostly observed around the buildings. A nest containing one egg only was found in the first week of June. On June 28, an adult accompanied by a fledgling was observed for several hours. A female in breeding condition was collected on May 26.

*Vireo solitarius solitarius* (Wilson) SOLITARY VIREO. Very rare in the area, probably due to the relative scarcity of mixed deciduous stands. The following observations were made: May 21 (2); June 4 (1); and August 24 (1).

*Vireo olivaceus* (Linnaeus) RED-EYED VIREO. At Lac de la Grande Baie, two birds were observed on July 23; one of them sang repeatedly.

*Vermivora peregrina* (Wilson) TENNESSEE WARBLER. Common in mixed and pure coniferous stands from June 5 to September 26. It seemed to prefer stands where birch, *Betula papyrifera* and *B. lutea*, was present. A few specimens were collected.

*Vermivora ruficapilla ruficapilla* (Wilson) NASHVILLE WARBLER. Single individuals observed in a deciduous stand on June 1 and 4.

*Parula americana* (Linnaeus) PARULA WARBLER. One bird was observed in a deciduous stand on July 23 near Lac de la Grande Baie.

*Dendroica petechia amnicola* Batchelder YELLOW WARBLER. Uncommon summer resident. Noted as follows: Lac Ste. Anne, June 11 (1); August 17 (1), 30 (1). Lac de la Grande Baie, July 23 (1). Two specimens were collected at Lac Ste. Anne: an adult male on June 11 and a juvenile male on August 17.

*Dendroica magnolia* (Wilson) MAGNOLIA WARBLER. Uncommon in the area. However, one to six individuals were seen almost daily from June 1 to August 30. An adult male was collected on July 6.

*Dendroica coronata coronata* (Linnaeus) MYRTLE WARBLER. Common summer resident. Observed from May 18 to September 31. From May 19 to 28 ten to forty individuals were seen daily in various types of vegetation. The resident birds were mostly observed in coniferous stands. On July 15, an adult was observed with two fledglings; and another, on July 20, with a juvenal. A few specimens were collected.

*Dendroica fusca* (Müller) BLACKBURNIAN WARBLER. A male was heard and seen on June 9.

*Dendroica castanea* (Wilson) BAY-BREASTED WARBLER. Single males were heard and seen on June 9 and 18.

*Dendroica striata* (Forster) BLACKPOLL WARBLER. Uncommon summer resident. Observed irregularly from June 9 to September 30. Probably breeds in the area. Three specimens were obtained, two of which were in breeding condition.

*Seiurus aurocapillus aurocapillus* (Linnaeus) OVENBIRD. One bird was heard and seen on June 10.

*Seiurus noveboracensis* ssp. NORTHERN WATERTHRUSH. Common summer resident. Observed commonly along streams and water bodies, from July 5 to September 24. A female with an incubation patch was collected on July 8 and a juvenile male on August 18. The female collected on July 8 has the following measurements (in mm): wing, 71.9; tail, 48; exposed culmen, 12.5; tarsus, 21.2. Compared with series from western Canada, it is greener above and almost as whitish below. It is, therefore, considered as tending towards *noveboracensis*.

*Oporornis philadelphia* (Wilson) MOURNING WARBLER. A male was heard and observed on June 12.

*Geothlypis trichas brachidactylus* (Swainson) YELLOWTHROAT. Uncommon summer resident. The following observations were made: July 2 (1); August 18 (1), 24 (1), 30 (1); and September 4 (1). A juvenile male was collected on August 18.

*Wilsonia pusilla pusilla* (Wilson) WILSON'S WARBLER. Common summer resident in shrubbery along streams and wet places. Observed from June 4 to September 26. Three specimens were collected.

*Wilsonia canadensis* (Linnaeus) CANADA WARBLER. Single individuals were heard and seen on May 31; June 1 and 2.

*Setophaga ruticilla tricolora* (Müller) AMERICAN REDSTART. Three single males seen on May 29; June 10 and 18.

*Agelaius phoenicus phoenicus* (Linnaeus) RED-WINGED BLACKBIRD. Two males were observed in a grassy area near the lake on May 27.

*Euphagus carolinus* ssp. RUSTY BLACKBIRD. Observed commonly from May 18 to 26. Single birds were observed on August 9 and 26. An adult female was collected on September 26.

*Molothrus ater ater* (Boddaert) BROWN-HEADED COWBIRD. Common from May 18 to 26. A few specimens were collected. A juvenile was observed on September 5.

*Hesperiphona vespertina vespertina* (Cooper) EVENING GROSBEAK. Single individuals were seen on June 3 and 4.

*Carpodacus purpureus purpureus* (Gmelin) PURPLE FINCH. Uncommon summer resident. Observed irregularly from May 20 to September 10. An adult male and female in breeding condition were collected on June 20.

*Pinicola enucleator* ssp. PINE GROSBEAK. Resident. From July 4 to 31, two adults were regularly observed at Lac Ben Louis; on August 11 they were seen with fledglings.

*Spinus pinus pinus* (Wilson) PINE SISKIN. Common in summer. Observed regularly from May 21 to September 30. On July 7, an adult accompanied by three fledglings was observed for several hours. A few specimens, both juvenile and adult, were collected.

*Spinus tristis tristis* (Linnaeus) AMERICAN GOLDFINCH. Rare in the area. The following observations were recorded: May 29 (2); June 1 (1), 3 (1), 5 (1), 10 (2), 17 (1); July 13 and 18 (1).

*Loxia leucoptera leucoptera* Gmelin WHITE-WINGED CROSSBILL. Very common summer resident in 1959. Observed from June 12 to September 30. On August 25, two males were seen with six fledglings in a thick black spruce stand. Several specimens were collected.

*Passerculus sandwichensis* ssp. SAVANNAH SPARROW. Uncommon spring and fall transient. Observed from May 24 to June 7, and September 9 to 28. Probably does not breed in the immediate vicinity of Lac Ste. Anne on account of the lack of suitable habitat. A few specimens were collected and are considered as intergrades between *labradorius* and *savanna*.

*Junco hyemalis hyemalis* (Linnaeus) SLATE-COLORED JUNCO. Common summer resident from May 26 to September 30. Noted mostly in open mixed and pure stands of both coniferous and deciduous species. A female feeding three young was observed on July 21; on August 14, two adults were observed with two juvenals. A few specimens were collected.

*Spizella arborea arborea* (Wilson) TREE SPARROW. Two were observed on September 5.

*Spizella passerina passerina* (Bechstein) CHIPPING SPARROW. A few individuals were observed in the earlier part of the summer, up to the end of June. They were seen mostly around the buildings. An adult male in breeding condition was collected on June 19.

*Zonotrichia leucophrys leucophrys* (Forster) WHITE-CROWNED SPARROW. Very common spring and fall transient. Observed from May 17 to June 1 and from September 19 to October 1. An immature male was collected on September 19.

*Zonotrichia albicollis* (Gmelin) WHITE-THROATED SPARROW. Very common summer resident. Observed from May 18 to October 1. Several family groups were observed during the summer. A few specimens were collected.

*Passerella iliaca iliaca* (Merrem) FOX SPARROW. Four were seen in a dense black spruce stand on May 17.

*Melospiza lincolnii lincolnii* (Audubon) LINCOLN'S SPARROW. Uncommon summer resident. Observed from May 17 to September 24. Mostly seen in low vegetation at the edge of black spruce stands. At thirty miles north of Godbout, two adults were seen with a juvenal on June 23. Two adult males were collected on June 22 and August 29.

*Melospiza georgiana ericrypta* Oberholser SWAMP SPARROW. A single bird was seen in alders along a brook on June 9 and 10.

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# CRESTED MYNAH IN BRITISH COLUMBIA

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The Crested Mynah, *Acridotheres cristatellus*, a bird native to southeast Asia, was introduced into Vancouver, B.C., in the 1890's apparently by an oriental resident of the city. The first reliable report for Vancouver was in 1897 and the first specimen was collected near the Vancouver water front in 1904. A few Crested Mynahs soon spread to Vancouver Island, with casual visitors south across the border to the states of Washington and Oregon. For some time it was feared that the Crested Mynah might become a serious pest on the Pacific Coast, because its aggressiveness had already established it firmly elsewhere, as in Formosa, the Philippines, and Japan. The writers commenced field studies in the Vancouver area in 1959, as very little information had been published on the Crested Mynah since the 1935 report of Scheffer and Cottam. The field investigations have been focused on a study of Crested Mynah distribution, numbers, and nesting habits.

## Distribution and Numbers

The Crested Mynah appears to be confined to the immediate vicinity of Greater Vancouver with the exception of a small colony on Vancouver Island at Nanaimo, B.C. Population estimates for Vancouver City and vicinity in 1959 were greatly facilitated by a public appeal, made through local newspapers, for information on nesting sites. Well over one hundred telephone calls were received and it was felt that most of the information on the Crested Mynah's distribution was reliable because the bird is easily recognized as a Robin-sized "blackbird" with sharply contrasting round white wing patches. Large flocks of such birds in the recent past have also made them familiar to most residents of the Vancouver area. Some reports, however, were obvious duplications or erroneous, and these were ignored. The 1959 survey was conducted during the first week in March after the break-up of winter roosts. The distribution is plotted in Figure 1.

As far back as 1920, with a big wintering roost at Carroll and Cordova Streets, the population was estimated at 1,200. Numbers increased in the next five years to an estimated 7,000, with a maximum population of 20,000 being reported in 1927 (Scheffer and Cottam, 1935). During the peak population years of the mid-twenties, Crested Mynahs were abundant on the North Shore but in 1959 only two birds were reported and the dubious sightings were not verifiable. In 1959 Crested Mynahs were observed as far east as the eastern limit of New Westminster. No sightings were received for areas south of the South Arm of the Fraser River, although birds were observed, in number, on Lulu Island and, to a lesser extent, on Sea Island, both in the Fraser Delta.

The aggregate population reported for 1959 by over one hundred non-professional observers was about 2,500. Since many sightings may have been

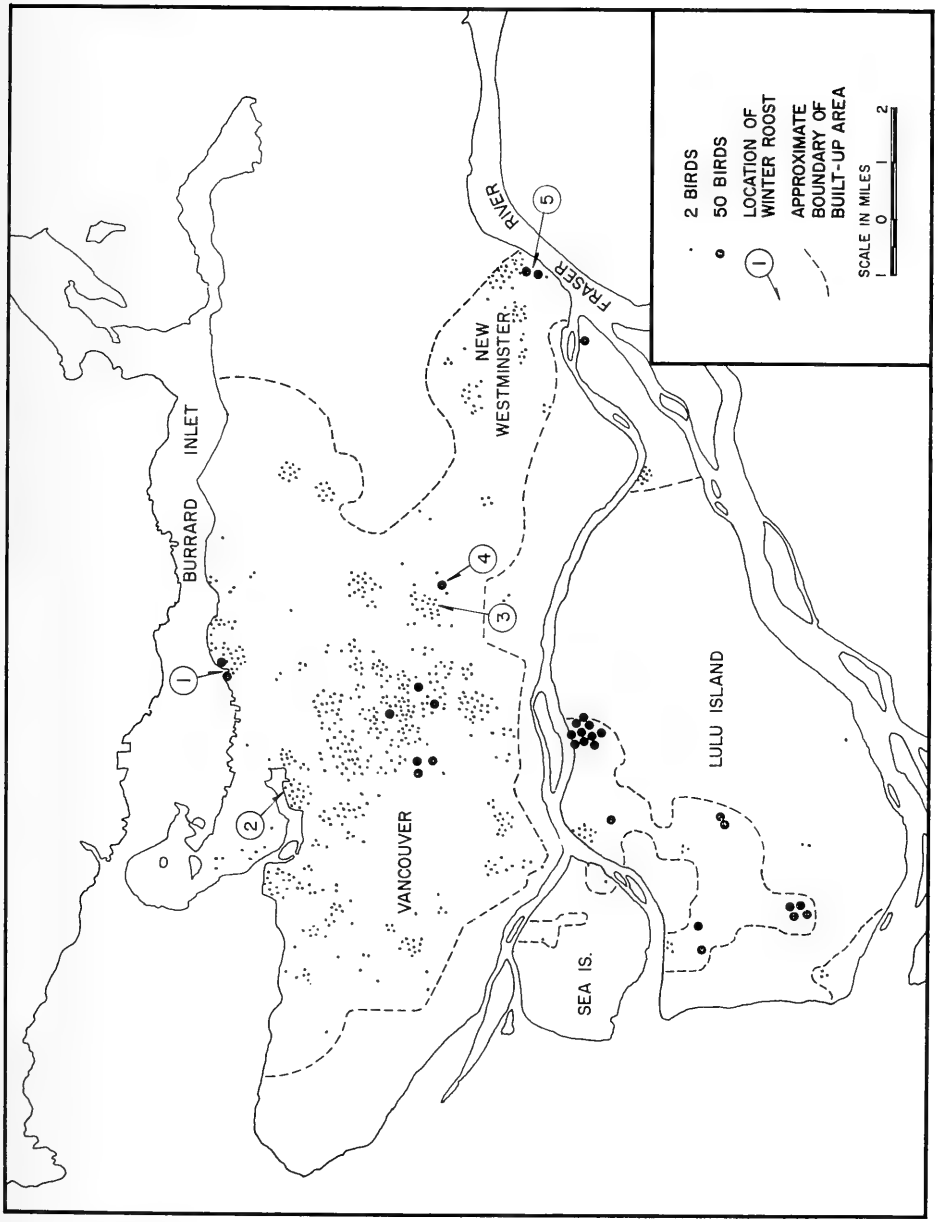


FIGURE 1. Distribution Map of Crested Mynahs, 1959-60. The 1959 spring distribution is shown by the dots and solid small circles, representing two and fifty birds, respectively. The locations of winter roosts in 1960 are numbered and correspond to the list in the text. The approximate boundary of the built-up area is shown with a dashed line.

duplications, the actual population was probably much smaller, as independent evidence suggests that few birds were missed in the count. However, the regional distribution is believed to be essentially correct (Figure 1).

The Nanaimo observations, of recent date, were made in 1959 by K. R. Beckett who observed at least nine birds during the nesting season, some of which were carrying nesting material. W. J. Merilees saw birds in the same area in December 1960. It seems probable that the Nanaimo population, like that of Vancouver, is non-migratory.

In winter, Crested Mynahs gather in large flocks to roost (Munro, 1922), as in their native habitat of southeast Asia (Vaughan and Jones, 1913). Information on the location of winter roosts resulted from a second public appeal, and the response was such that probably all winter roosts of any appreciable size were located. Many visits were then made to the roosts, so that reasonably accurate counts were obtained of bird numbers. The principal roosts of Vancouver-New Westminster are listed below with the numbers of the roosts corresponding to those in Figure 1:

| | | |
|---|---|---|
| 1) | Lapointe Pier | 600 |
| 2) | Connaught Bridge | 500 |
| 3) | Sir Guy Carleton School | 150 |
| 4) | Collingwood United Church | 20 |
| 5) | Russell Hotel (New Westminster) | 60 |
| | TOTAL | 1,330 |

In addition, there were an estimated 800 Crested Mynahs on Lulu Island. Efforts to locate a large roost on the island were unsuccessful, so it probably did not exist. The Lulu Island birds are approximately four miles from the nearest Vancouver city roost. As no back-and-forth movement was observed, the total 1960 population for the Vancouver area was at least 2,130. This figure is probably fairly accurate because it is most unlikely that any sizable roost was omitted in the count. The overall agreement of the 1959 and 1960 surveys suggests that the total Crested Mynah population of the greater Vancouver area is 2,000 to 3,000 birds, a sharp decrease from the high of 20,000 in 1927. The forebodings of a Crested Mynah plague in the Vancouver area (McAtee, 1925) have so far failed to materialize. With the recent invasion of the European Starling into the region and the competition for nesting sites, the position of the Crested Mynah may deteriorate.

The distributional pattern shows that the Crested Mynah is an urban dweller in the Vancouver area (Figure 1). In the treed areas, notably Stanley Park and the University Endowment Lands, Crested Mynahs are conspicuously absent. In the suburban areas of Lulu and Sea Islands, Crested Mynahs are observed about houses and nearby open fields.

## NESTING HABITS

Nest boxes were utilized to study the nesting habits of the Crested Mynah. By March 30, 1959, twelve boxes had been placed on telegraph poles on Lulu Island in an area where the birds were known to nest. The boxes varied in

their compass orientation; each box was placed approximately twelve feet above the ground on poles that were fifty yards apart. On one pole, two boxes were fastened back to back. Furthermore, some of the poles contained natural cavities.

Judging from initial observations, Crested Mynahs seem to prefer natural cavities to nest boxes, although they readily occupy boxes in the absence of natural cavities. According to Vaughan and Jones (1913), the Crested Mynah may nest in colonies in its native habitat but this was not observed in the Vancouver area. When a pole had two nesting sites, invariably only one site was occupied.

Although there was no positive proof, evidence suggests that the Crested Mynah may build "false" nests. This was observed on four occasions. For example, when a box was on a pole with a natural cavity, the birds chose the cavity for nest building and egg laying; however, an unoccupied nest was built in the box. On the pole with boxes back to back, there were nests in both boxes but eggs were laid only in one.

Nests in the city are usually located in telephone pole cavities, bird houses in residential areas, and about older buildings which afford some sort of nearly enclosed nesting shelter. One pair of Crested Mynahs has even been reported to have nested in the folds of a store awning during a period when it was not lowered. Nest sites vary in height from a low of only four feet above the ground in a tree to others sixty feet up in tall trees.

The nest is untidy. It comprises coarse dead grass, feathers, green leaves, charred paper, bits of fur and hair, grass roots, twigs, and any other available material. Curiously enough, most nests contain a bit of cellophane. Cellophane from cigaret packages was found in twenty-six nests examined, as many as five pieces being incorporated into a single nest. Strips of cellophane seem to have replaced the discarded snake skins which Vaughan and Jones (1913) observed in nests near Hong Kong. Although no snake skins were encountered, they were available in the area. The most unusual material was aluminum shavings used in a nest in an industrial area.

In 1959 nest building began in early April and continued sporadically through July. The earliest egg laying date recorded in 1959 was April 12 but in 1960 it was April 23 (Table 1). The mean ten-day temperature prior to the earliest egg laying was 47.5°F in 1959 and 46.7°F in 1960; the mean daily temperature was about 50°F. In the Hong Kong-Macao area of south China, Vaughan and Jones (1913) report egg laying from April 15 onwards, when the mean daily temperature is about 70°F, or about 20°F warmer than at Vancouver.

Incubation of the Crested Mynah begins with the laying of the final egg and lasts fourteen days. The 1959 and 1960 study showed that on the average it took forty days from the laying of the first egg until the fledging of the young. Most frequently, clutches contained five eggs although as few as three eggs and as many as six were laid (Table 2). Vaughan and Jones (1913) report that a four egg clutch was most common in the Hong Kong area.

In 1959 a total of ninety-seven eggs were laid, but sixty-three did not hatch. Hatching loss was due partly to egg destruction (20 per cent) but primarily to

TABLE 1. — First Laying Date (when known) and Size of Clutch

| Date First Egg of Clutch Laid | Clutch Size |
|---|---|
| 1959 | |
| April 12 | 5 |
| 21 | 5 |
| 22 | 5 |
| 23 | 6 |
| 25 | 5 |
| 26 | 5 |
| May 2 | 5 |
| 10 | 5 |
| 14 | 5 |
| 25 | 4 |
| 30 | 6 |
| June 11 | 5 |
| 22 | 6 |
| July 4 | 4 |
| 4 | 4 |
| 31 | 4 |
| 1960 | |
| April 23 | 6 |
| 27 | 3 |
| 28 | 5 |
| May 29 | 6 |
| June 25 | 3 |
| 26 | 4 |
| 27 | 4 |
| 29 | 5 |

a failure in the hatching process itself (71 per cent). In 1960, of the sixty eggs laid, thirty-six did not hatch. In this case, hatching failure caused three-quarters of the loss and egg destruction accounted for the balance. In 1959 European Starlings attempted to take over some of the nest sites. Although they were unsuccessful, it may be that they had a disturbing influence on the Crested Mynahs under observation, because it was during this period that several of the clutches were destroyed. In contrast, no European Starlings were observed in the nesting area during 1960. Only two instances of human interference, one during each nesting season, were encountered.

Once the eggs have hatched, survival rate is high until the fledging. In 1959, 79 per cent of the hatched nestlings were fledged, and the following year 87 per cent of the hatched nestlings left the nest. It appears that the birds under observation have a poor reproductive rate which results primarily from difficulty during the incubation stage rather than after it.

TABLE 2. — Eggs Laid and Hatching Success or Failure

| Clutch Size | Number of Clutches by Size | Number of Eggs Laid | Eggs Destroyed (Cause Unknown) | Unhatched Eggs | Hatched Eggs | Nestlings Died | Nestlings Fledged |
|---|---|---|---|---|---|---|---|
| | | | 1959 | | | | |
| 1* | 2 | 2 | | 2 | | | |
| 2* | 1 | 2 | 2 | | | | |
| 3 | 2 | 6 | 3 | 3 | | | |
| 4 | 6 | 24 | 8 | 4 | 12 | | 12 |
| 5 | 9 | 45 | 5 | 22 | 18 | 7 | 11 |
| 6 | 3 | 18 | | 14 | 4 | | 4 |
| | 23 | 97 | 18 | 45 | 34 | 7 | 27 |
| | | | 1960 | | | | |
| 3 | 1 | 3 | | | 3 | | 3 |
| 4 | 5 | 20 | 4 | 8 | 8 | 2 | 6 |
| 5 | 5 | 25 | 5 | 18 | 2 | | 2 |
| 6 | 2 | 12 | | 1 | 11 | 1 | 10 |
| | 13 | 60 | 9 | 27 | 24 | 3 | 21 |

*Egg laying terminated abruptly for unknown reasons before clutch completed.

A total of 162 eggs were examined and measured, 102 in 1959 and 60 in 1960. All measurements were made with vernier calipers reading to 0.1 mm. The mean length for the 162 eggs was 31.0 mm with a standard deviation of 1.2 mm; the mean width was 21.4 mm with a standard deviation of 0.6 mm. These figures do not differ significantly from mean values of 30.6 and 21.7 mm for 19 eggs measured by Bent (1950) and 29.5 and 21.6 mm for south China eggs (Vaughan and Jones, 1913).

On a statistical basis, there is strong evidence to suggest that a pair of Crested Mynahs laid three clutches in one box. Commencing April 26, five

TABLE 3. — Comparison of 1959 and 1960 Clutches

| | Number Clutches | Clutches Destroyed | Complete Clutch Failed to Hatch | Complete Clutch Hatched | Clutches with Partial Hatching Success |
|---|---|---|---|---|---|
| 1959 | 23 | 5 | 9 | 3 | 6 |
| 1960 | 13 | 2 | 4 | 4 | 3 |
| TOTAL | 36 | 7 | 13 | 7 | 9 |

eggs were laid in a box, the eggs being remarkably long, averaging 32.7 mm as compared to the mean length of 31.0 mm. The clutch was destroyed. Commencing two weeks later, on May 14, another clutch was laid in the same box. These five eggs, like those of the preceding clutch, were also exceedingly long, averaging 33.3 mm. Starting July 4, another clutch of four eggs was laid. These eggs were also long, averaging 32.1 mm. If the mean lengths of the three clutches are compared with the "population" mean length of 31.0 mm, using the t-distribution, the mean lengths of the first and second clutches differ significantly, at the 1 per cent level, and that of the third at the 10 per cent level from the "population" mean. This suggests that the three clutches may have been laid by the same bird. In addition, the interval of fifty-four days between the successful clutches with first egg laying dates of May 14 and July 14 also reinforces the possibility of a second brood.

The color of the egg is nearly the same as that of the Robin; it is a light blue-green (BG 6/2 on the Munsell color scale) with no markings.

Crested Mynahs seemed to follow a general pattern in nest building in boxes. First, for several days coarse grass and other material was carried into and left on the bottom of the nesting box. Then the loose material was compacted and pushed up the front inside of the box towards the entrance hole, often leaving the bottom completely bare. More material was then added to cover the floor of the box to a depth of one or more inches at the bottom back. Thus, the nesting material sloped gently downwards from front to back. A slight, feather-lined cup completed the nest. Some birds seemed to add green leaves and other material to the nest throughout incubation.

The record of one next box illustrates the sequence of nesting events. Nest building commenced on April 20. Five eggs were laid on five successive days, commencing May 2. Three young hatched on May 20 and a fourth by the 21st. The fifth egg, which failed to hatch, contained a well developed embryo. Hatching weights were: 5.0, 6.6, 6.2 and 7.1 grams. On May 23 the smallest nestling had disappeared from the box, and the nest had been disturbed by the addition of many leaves. The three remaining young opened their eyes on May 28. On June 1, twelve days after hatching, the nestlings showed signs of fear when the nest box was opened. At the end of twenty days, on June 9, the young birds were well feathered. Their white wing patches quickly identified them as mynahs although their plumage was still a sooty black, their eyes remained blue, and their feet and legs were horn-like in color. Their weights had increased to: 83.6, 70.5 and 71.2 grams, respectively. On June 10 the nest box was empty and presumably the young had safely fledged. A total of fifty-one days had elapsed from the first day of nest building to the fledging of the young. Although the young were banded, they were never seen again.

Experience with a hand-reared Crested Mynah has shown that the crest is acquired after the post-juvenile molt when the plumage comes in glossy black. By that time, the iris has become yellow with a thin outer rim of orange.

## General Observations

Adult Crested Mynahs are most often seen in pairs. When one is spotted, a quick look around usually discloses a second bird nearby. This appears to be

true at any time of the year. The time of formation of winter roosts in the Vancouver area has not been established.

Crested Mynahs, unlike their near relative the European Starling, have not been observed in aerobatic manoeuvres before roosting in the Vancouver area, although they are reported to do so in their native habitat. Birds in pairs or small groups, flying relatively low, move into the outer reaches of a roosting area. Thereafter they travel leisurely, often on the ground where they may feed, until roosting time. In the late afternoon on sunny days they often sit about the roosting area in the lingering rays of the setting sun and occasionally burst into song.

Crested Mynahs seemingly prefer to associate with their own kind, and were not noted among the large flocks of mixed "blackbirds" wintering on Lulu and Sea Islands, although Scheffer and Cottam (1935) report them as associating with Brewer's Blackbirds.

On Lulu Island birds were often seen feeding among grazing cattle and, although it is not a common occurrence, birds have been seen resting on the backs of cattle.

The Crested Mynah has its own distinctive and melodious song (Taverner, 1934) but it also mimics those of other birds, the call of the Redwing having been especially noted by the authors.

The adult Crested Mynah is a wary bird, and attempts to net adults for banding purposes in a nesting area were entirely unsuccessful despite long hours spent on the project.

## SUMMARY

In the sixty-five years since it was first reported in Vancouver, the Crested Mynah has not spread significantly and still remains confined to the general area of Greater Vancouver, with the exception of the small resident population at Nanaimo, B.C. Greater Vancouver's present Crested Mynah population of between 2,000 and 3,000 birds represents a sharp numerical decline in the last thirty-five years. Birds still gather in large roosts during the winter months but spread throughout the built-up areas during the breeding season. In the Vancouver area the Crested Mynah does not nest in colonies, and it is by preference a cavity dweller. The time of nesting is similar to that of birds in south China, although the corresponding mean daily temperatures are about 20°F lower in Vancouver.

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# KEEPING SMALL AMPHIBIANS AND REPTILES IN HOME-MADE TERRARIA

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THE WRITER AND HIS FAMILY have successfully kept various amphibians and reptiles for periods as long as three years. They are fascinating to watch and in some cases become quite tame. We have had as many as forty individuals of eight species on hand at one time yet found they can be housed and fed very economically. Large terraria, such as those sold by pet shops, are very good, but these are expensive and we have found by trial and error that the smaller home-made terraria have proven just as satisfactory at a trifle the cost. The animals are comfortable and healthy if well cared for and the containers are satisfactory for long periods. It is felt that the following information may be of interest to young and old naturalists who enjoy pets but are under the impression that amphibians and reptiles are difficult to house and a nuisance to feed.

## EQUIPMENT

Inexpensive home-made terraria and aquaria can be made from 128 ounce pickle or mustard jars, which can be purchased from restaurants for about twenty-five cents. Smaller household jars, such as peanut butter and mayonnaise, with wide lids are excellent for smaller salamanders and frogs. Cut a circular hole in the centre of the lid leaving a narrow half-inch rim. Cut a matching hole through the inner cardboard seal. Now put a piece of screening inside the lid and insert the cardboard ring to hold the screen in place (Figure 1). The best way to keep the terrarium moist is to use moss. It is important to have a good supply on hand if the pets are to be kept over winter. The moss may be gathered in summer and dried and stored in boxes until needed. Moss in a terrarium should be changed about once a week. It can be washed in

cold water, allowed to dry and be used over again several times. It is advisable to have an extra jar handy to hold the pets while their terrarium is being cleaned.

FOOD

A culture of the white worm *Enchytraeus* (also called thread worm) is essential if one is going to keep certain species during the winter months. Enough white worms to start a culture may be purchased at pet shops for about fifty cents and are kept as follows: Fill a 128 ounce jar with rich moist earth to a point about four inches from the mouth. Put the worms in the jar and on top of the earth place half a slice of bread which has been soaked with milk or water, then cover with a damp piece of folded newspaper. Keep the worm jar in the cellar or similar cool place. It is necessary to change the bread at least once a week and also add some water to the earth, which should be kept moist. Where white worms are mentioned as food in this article, the feeding method is simply to drop them into the terrarium and leave them. Meal worms *Tenebrio molitor*, are another good source of winter food supply. Enough to start a colony can be purchased through pet shops and they can be kept in dry oatmeal in a 128 ounce jar. These are also dropped into the terrarium alive.

In summer it is useful to have a fly trap which may be made from a narrow necked 28 ounce jam jar. Glue a small piece of liver inside the bottom of the jar and place it outside on a window sill. (It helps to trap the flies in the jar if a paper funnel is placed in the neck of the jar). When ten or twelve flies are in the jar place hand over top of jar to keep flies from getting out. Then remove lid of terrarium and insert the fly trap upside down in open mouth of 128 ounce terrarium. During the months when flies, grubs and worms are plentiful the pets may be fed each day or every second day. But as fall days grow shorter the pets get less active and require feeding only once a week or once a month. By observing the animals one can judge for onself as to how much food they need.

The dry processed turtle food sold at pet shops does not contain the vitamins and minerals necessary for a balanced diet. Turtles fed entirely on this type of food will die from nutritional deficiencies.

Force feeding of snakes is sometimes necessary but should only be done after other feeding methods have failed. When force feeding one must be extremely careful so as not to injure the mouth. A pair of blunt tweezers are satisfactory if handled with care. Grip the snake gently just back of the head but not near the throat or the snake will not be able to swallow. If you cannot open the snakes mouth with your finger use a wooden tongue depressor. Now pick up a small piece of meat or liver with the tweezers and very gently work the food into the snakes mouth, being careful as you near the throat. After a little practice you will be able to force feed the snake without too much difficulty, and in time the snake should start to feed naturally. Salamanders, toads, frogs and snakes which are too small to be force fed or ones that continually refuse to eat for longer than a month (during warm weather) should be turned loose in their natural habitat. Of course, this does not apply during the cooler weather as sometimes a specimen will fast for several months without any apparent harm.

### TEMPERATURE

Amphibians will feed well at house temperatures from 60° to 75°. In fact some species such as the Dusky Salamander (whose natural habitat is the cold spring brooks) will do well at 55°. During the hot weather aquaria and terraria should not be left near a window in the direct rays of the sun as the jar may become overheated and the amphibians will die, even if in the water or under cover such as moss. Five minutes in dry warm air can prove fatal to small salamanders. The Gray Treefrog can tolerate the sun up to fifteen minutes if the temperature is not too high. Reptiles feed well at house temperatures of 70° to 80°. Some snakes are unable to digest their food at low temperatures of approximately 40°. Prolonged exposure to the sun can be harmful or fatal to reptiles also.

### HIBERNATION

If one should run out of proper food for amphibians during the winter months they may be stored alive in the refrigerator at temperatures of 35° to 40°. This does them no harm for they naturally hibernate during the winter. They require no food while they are in the refrigerator. To properly store amphibians in this manner secure a jar of suitable size and punch a few air holes in the lid, drop in a piece of wet absorbent cotton and place specimens in the jar. Each week replace the absorbent cotton and let a few drops of cold water drip from a spoon over the amphibians to keep their skin moist.

### DISEASE

Probably the most common disease among frogs and toads kept in captivity is the red leg disease. It is easily diagnosed by a reddening of the skin on the underside of the hind legs and if left unchecked will result in death. A terrarium which is too wet helps to contribute to this disease. If the disease is well advanced and the reddening has extended from the hind legs on to the belly it is best to let the pet go in its natural habitat. Sometimes it helps to curb the disease in its early stages if infected specimens are placed in a jar and stored in the refrigerator for about a month in the same manner as mentioned under *Hibernation.*

SPOTTED SALAMANDER *Ambystoma maculatum,* BLUE-SPOTTED SALAMANDER *Ambystoma laterale,* TIGER SALAMANDER *Ambystoma tigrinum*

A 128 ounce jar is sufficient to hold one Tiger Salamander, two Spotted Salamanders, or two Blue-Spotted ("Jefferson's") Salamanders and can be made up simply by adding damp moss to a depth of an inch and a half. A secure cover (lid) must be used as these salamanders are able to climb quite easily. Feed them in the following way: Start by dangling a piece of hamburg or liver on the end of a thread in front of the salamander. If some flies are placed in the terrarium while the meat is being offered it will encourage the salamander to eat more readily. The salamander will try to catch the flies and at the same time will quite often reach for the meat. Any of these species will eat flies but it is better to get the pets feeding on meat as quickly as possible as flies are unobtainable in the winter. They will eat white worms and meal worms. It is important to keep the moss damp (but not wet) as the salamander takes in water through its skin. It is a good idea while cleaning the terrarium to let the salamander have a swim in a dish of cool (not cold) water for a few minutes. It should be remembered that amphibians will die if placed in warm water. The food found best for recently transformed salamanders of these species is white worms; about three worms per day to start with.

SPOTTED NEWT *Diemictylus viridescens*

The aquatic adults are very hardy and attractive salamanders. A twenty-four ounce jar is sufficient for two specimens and a 128 ounce jar for five or six. Pour water into the jar until it is about half filled and add a bit of water plant (*Elodea*) and a small piece of wood which will float in the water. The newts will climb up on the wood and if some white worms are placed on it they will feed readily. They seem to feed well on white worms and flies which are dropped into the water. The terrestrial eft of this species may be kept in the same type of terrarium as described under Spotted Salamander and fed on white worms and live flies.

TWO-LINED SALAMANDER *Eurycea bislineata*; DUSKY SALAMANDER *Desmognathus fuscus*

A twenty-four ounce jar is sufficient to hold two salamanders. In nature both species live in or near the water. Place a handful of fine gravel in the jar and a stone about one-third the diameter of the bottom of the jar and approximately one inch thick on top of the gravel. Pour in enough water to cover the gravel and part of the stone. This will give the salamander a chance to partly hide around the stone but at the same time not get completely out of sight. White worms have been found to be the best food but they will also eat small flies and grubs. Young two-lined salamanders have external gills and should be placed in an aquarium and fed on white worms and packaged fish food until transformed.

RED-BACKED SALAMANDER *Plethodon cinereus*

A twenty-four ounce jar will house two of these salamanders. Place about one inch of moist rotted wood in the jar and add a little damp moss. The moss should be kept damp at all times. Feed with white worms, small grubs and insects.

AMERICAN TOAD *Bufo americanus*

A 128 ounce jar will hold an average size toad. Place in the jar a water dish about an inch and a half in depth and one-third the area of the bottom of the jar. Fill up the remainder of the bottom of the terrarium with dry sandy earth to a depth of an inch and a half. The toad will keep the earth moist by jumping in and out of the water dish. Put fresh water in the dish each day and change the earth each week. The toad's

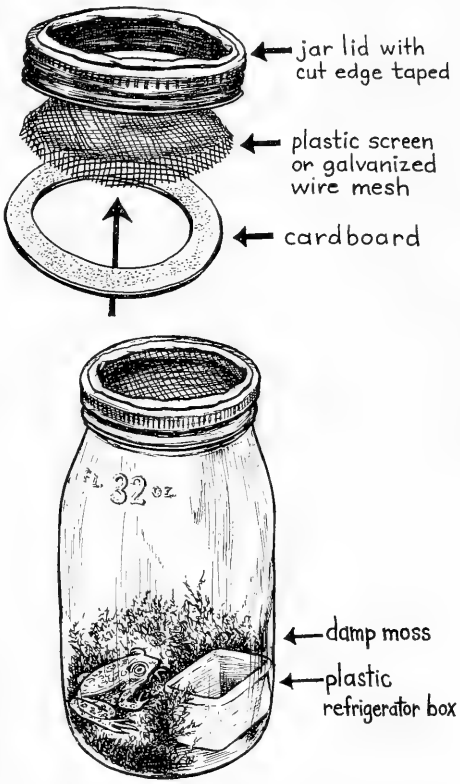


FIGURE 1. Drawings of method of making suitable jar lid (above) and a typical finished terrarium (below).

favourite food is flies but they will also eat insect larvae, earth worms, beetles and meal worms. During the winter months our toads seemed to remain in partial hibernation and buried themselves in the earth. They were placed in a wooden box filled with equal portions of sand and earth and kept in the basement. It is necessary to keep the earth slightly damp.

SPRING PEEPER *Hyla crucifer*

A twenty-four ounce jar is sufficient for two peepers. Place about one inch of moss in the jar and a twig about the same diameter as a lead pencil so that the frog can climb on it. A water dish is not necessary if the moss is kept damp. The peepers' favourite food is small fruit flies, however, they can also eat house flies and often we have observed them swallow flies almost two-thirds their own size. They can be coaxed to snap at bits of

meat on a thread and will eat white worms at times. Make sure the lid is kept on the terrarium at all times unless you are actually feeding the frogs. (This rule should be followed with specimens that are able to climb or hop out of the terrarium). It is a good plan to check the lid when taking it off to see that none of the little frogs are clinging to the underside of it.

CHORUS FROG *Pseudacris triseriata*

These little frogs can be housed in the same sort of terrarium as the Spring Peeper; two specimens to a twenty-four ounce jar. They like to stay hidden and usually bury themselves in the moss. They are not shy as we have observed them many times when some flies are dropped in the terrarium snapping at house flies nearly half their own size and wrestling vigorously until they had swallowed them. In winter they can be induced to eat bits of liver or beef dangled from a thread, also they will eat white worms.

GRAY TREEFROG *Hyla versicolor*

A 128 ounce jar will hold four specimens. Place about one inch of moss in the jar and a stick, preferably one with a branch, about three quarters of an inch in diameter and five inches long. These pets seem to prefer house flies to all other food and one frog in a day will consume ten or more flies. They are fed easily with meat on a thread and make very good pets, some becoming so tame that they will eat flies off one's fingers.

GREEN FROG *Rana clamitans*

A 128 ounce jar is sufficient for one half-grown or two small Green Frogs. In the jar put a rock about half the area of the bottom and about three inches high. Pour into the jar about two inches of water thus leaving one inch of the rock above the water. Change the water regularly. These frogs feed very well and will eat all sorts of insects. Beef dangled from a thread or meal worms dropped on the rock will usually be taken during the winter months.

BULLFROG *Rana catesbeiana*

Full grown Bullfrogs are far too large to keep in 128 ounce jars. One small or half grown specimen is about the proper size. In making up the terrarium follow the same directions as given for Green Frogs. As a rule Bullfrogs are good feeders and may be fed on insects, worms, flies, beef dangled from a string, also they will eat minnows and small frogs.

PICKEREL FROG *Rana palustris*, LEOPARD FROG *Rana pipiens*

A 128 ounce jar will hold one Pickerel Frog or one medium size Leopard Frog. Put in a dish for water about an inch and a half in depth and about half the diameter of the bottom of the jar. Fill in around the rest of the area with small rocks and cover these with dry moss. In this way the frog has a chance to stay out of the water if he wishes to dry off. (In its natural habitat the Leopard Frog spends most of its time out of the water once the breeding season is over). They will eat flies, grubs, worms and during the winter they feed readily on meal worms which are dropped on the moss. When bits of hamburg about the size of a pea is dangled from a thread in front of them. they will snap at it.

WOOD FROG *Rana sylvatica*

A 128 ounce jar is sufficient for one adult or two medium size Wood Frogs. Place a small dish about an inch and a half in diameter in the jar and add enough moss around it to cover the bottom of the terrarium. Do not moisten the moss unless it becomes dry as the frog will usually keep the moss moist enough by hopping in and out of the water dish. This species is very fond of the larvae (grubs) of common beetles, also flies. In the winter feed them meal worms and on bits of liver dangled from a thread.

EGGS AND TADPOLES

Remove a few eggs as carefully as possible from the pond where they are laid and gather some of the algae or plant life found there. Place no more than a dozen eggs in a twenty-four ounce jar and fill about two-thirds full of water. Keep the jar at room temperature and when the tadpoles hatch they will feed on the algae for a few days. The water should be changed about every day or so and should be drained slowly holding a strainer over the mouth of the jar in case a tadpole wiggles out. Endeavour to add water which is about the same temperature as was previously in the jar. Water plants (*Elodea*), which may be purchased at pet shops, can be added to help keep the water fresh; about four or five inches of plant is plenty. The most convenient food is packaged fish food which should be sprinkled

on top of the water. Lettuce and tulip leaves will be readily nibbled. We have found that the crumbled yolk of a hard boiled egg makes an excellent food and is more nutritious than the prepared packaged foods However, care must be taken to see that only a small quantity of crumbled yolk is given at a feeding otherwise the water will be fouled by the uneaten material. When the tadpole develops hind legs a small piece of wood should be placed in the jar for the tadpole to partially come out of the water on, as it is gradually becoming an air breather. When all four legs are developed the tadpole is nearly transformed into a frog and it will sit on the wood a good part of its time. When the tail decreases in size the specimen should be put in a terrarium and kept as directed for its particular species.

PAINTED TURTLE *Chrysemys picta*

One small Painted Turtle, shell not exceeding two inches in diameter, may be kept in 128 ounce jar. A rock about half the size of the bottom of the jar and three inches thick should be placed inside. Pour about two and a half inches of water into the jar. In this way the turtle will have something to dry off on when it comes out of the water. These turtles will eat beetle larvae, live and dead flies, bits of hamburg, lettuce and cabbage. (One Painted Turtle we kept was very fond of cut up weiners). Canned salmon bones and pieces of sardine with oil washed off will provide variety. The food should be placed in the water as these turtles swallow their food in the water. Change the water regularly. It should be remembered that the pet will soon outgrow its home and therefore a larger aquarium will be necessary.

SNAPPING TURTLE *Chelydra serpentina*

A very small Snapping Turtle, shell not exceeding two inches in diameter, may be kept in the same type of aquarium as mentioned for Painted Turtles. Young snappers spend a great deal of their time in the water and they will eat minnows, beetles and bits of beef.

WOOD TURTLE *Clemmys insculpta*, BLANDING'S TURTLE *Emys blandingi*

The young of these two species are not often found. An aquarium for the small ones may be made up similar to that of the Painted Turtle but do not add as much water. From our own observations both species are able to swallow their food in and out of the water. They will eat beef, minnows, insects and also are fond of lettuce, cabbage, berries and pieces of banana.

GARTER SNAKE *Thamnophis sirtalis*

A 128 ounce jar is sufficient for a Garter Snake approximately twelve inches in length. Place about two inches of dry sandy soil in the jar and imbed a small dish of water. Put in some bark for the snake to hide under, and a stick for it to climb on. This snake must have a fairly dry terrarium but water should be kept in the dish. Tie liver or meat on a string and bounce it in front of the snake in a manner similar to that of a toad hopping, to induce the snake to eat. If a small frog is placed in a jar beside the snake's terrarium it will often excite the snake and help induce it to take the meat. Once the snake begins to eat readily the meat may be fed with tweezers. Sometimes it may be a month or more before the snake can be induced to accept beef or liver. Garter Snakes will eat live frogs and toads.

MILK SNAKE *Lampropeltis doliata*

Make up the same kind of terrarium for a twelve inch Milk Snake as you would for a Garter Snake. Milk Snakes will eat small snakes, frogs and toads and are particularly fond of mice. They ate the live crickets and beetles which we dropped into the terrarium.

CREEN SNAKE *Opheodrys vernalis*

The Green Snake can be housed in a terrarium similar to that described for the Garter Snake, but a few dry leaves should be added. These snakes become very tame and during the summer will eat insects and crickets. During the winter they can be coaxed to eat meal worms. It is difficult to get them to eat small strips of beef but this can be accomplished with a little patience.

RED-BELLIED SNAKE *Storeria occipitomaculata*

Two or three specimens can be kept in 128 ounce jar. Place about one to two inches of moist earth in the jar. Add a few pieces of bark and imbed a small water dish in the earth. Feed them small earth worms in the summer and white worms during the winter.

RING-NECKED SNAKE *Diadophis punctatus*

Make up the terrarium similar to that for the Red-bellied Snake, but have a slightly

larger water dish. These snakes are shy and in some cases are not good feeders. They will eat earth worms and small salamanders. In the winter the best food is white worms. If raw beef is cut in a strip to somewhat resemble the shape of a small salamander and dragged along the bottom of the terrarium the Ring-necked Snake will sometimes snap it up.

WATER SNAKE *Natrix sipedon*

A terrarium made from a 128 ounce jar is satisfactory for a Water Snake up to twelve inches long. Place a water dish two inches in depth and of sufficient size to cover half the bottom of the jar. Add rocks to the remainder of the bottom of the jar to a height of three to five inches. This will allow the snake to keep dry when it is out of the water. Water Snakes feed well on minnows and can be induced to eat small pieces of beef dangled along on a string. They also eat small frogs.

LARGE FROGS

Adult Bullfrogs, Green Frogs and Leopard Frogs can be housed in aquaria or terraria made from galvanized metal wash tubs. These can be made up in a manner similar to that mentioned for the smaller aquaria and terraria of the particular species. A good cover for the top of the wash tub may be made from window screening tacked on a wooden frame.

LARGE TURTLES

Adult Painted Turtles, Blanding's Turtles and Wood Turtles can also be quartered in a galvanized metal wash tub made up in the same way described for the young of the species. Put about four inches of water in the tub and add a few rocks of suitable size for the turtle to climb out on. Place the rocks in the centre of the tub so that the turtle can not climb out.

LARGE SNAKES

Adult Garter Snakes, Milk Snakes and Water Snakes can be kept in a wooden box approximately two feet long, one foot wide and one and a half feet in height. A hinged cover made with strong window screening tacked to a wooden frame is ideal. A glass front may be added. To make up the terrarium follow the same directions given for small specmiens of Garter, Milk and Water Snakes.

## ACKNOWLEDGEMENTS

I wish to thank Mr. Francis Cook, Curator of Herpetology, National Museum of Canada and Dr. Sherman Bleakney of Acadia University for reading the manuscript and offering helpful suggestions and criticism. Also I wish to thank Mrs. Lynn Bartosch, National Museum of Canada, for doing the illustrations.

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## CORRECTION NOTE

In Vol. 75, No. 4 of this journal, on p. 95, line 9, for *gluaca* read *glauca;* on p. 96, line 27, for in some of them secondary trees read in some of them the secondary trees; on p. 98, line 5, for Hewitt 1960 read Hewitt 1950; on p. 102, line 42, for food read fish; on p. 105, right column, line 28, for *norvegiica* read *norvegica.*

# REVIEWS

**North American Species of Hygrophorus**

By L. R. Hesler and A. H. Smith. 1963. The University of Tennessee Press, Knoxville, Tennessee. 432 pp. 116 figures. $12.00.

Owing to the scarcity of comprehensive and up to date monographs, the identification of higher fungi, usually known as mushrooms in North America, is ordinarily an arduous task. This is particularly true for the colorful and attractive species of the broad genus *Hygrophorus* for which European books are inadequate because of the large number of purely American entities. In the past, American agaricologists have extensively used the keys and descriptions by Peck (1907), Murrill (1916) and Kauffman (1918), but these references, although very useful, are not satisfactory, mainly because the descriptions are rudimentary and based almost entirely on macroscopic characters. During the past fifty or sixty years the progress performed in anatomical studies of higher fungi has been considerably utilized to improve the taxonomy of these plants and made possible the revision of their classification on the basis of more reliable and constant microscopic features.

The two authors of this new book began their studies on these fungi more than thirty years ago, and when they published in 1939 and in 1942 the first results of their work, the situation was clarified considerably by the addition of many new species and varieties with modern and detailed descriptions and a better grouping. This, however, was only the beginning, and the present book is the culmination of another twenty years of efforts.

In this recently published monograph of 416 pages, with 116 figures in black and white and one color plate, the authors have grouped and revised the information scattered in many publications, most of which are out of print, and they have added of course a large amount of new knowledge on this group of fungi. The introductory section contains historical data and a very detailed review of the literature and of their own contributions on the morphological characters, both macroscopic and microscopic, on which the classification of the species is based. This part is supplemented by pertinent comments on ecological relationships, geographical distribution, seasonal ocurrence, and on the place of this family in the taxonomy of Homobasidiomycetes.

Obviously, the authors are conservative in their treatment of this group of fungi, since they maintain the unity of the genus *Hygrophorus* as described by Fries in 1836. Although they do not follow the present trend of splitting classical genera, they recognize most of the previously known divisions to which, however, they ascribe an infrageneric rank. Furthermore, as a result of their own studies, they propose a new subgenus and five new sections and subsections, and a number of series. Irrespective of the level adopted for the various units, their classification appears to be sound and natural.

In the main part of the book, 216 species and 28 varieties and forms are fully described but in the usual concise form. In addition, useful and interesting notes on habitat, habit, distribution and relation with closely allied species are given. The black and white photographs of some 120 species and varieties are also helpful for the identification. The monograph is particularly valuable because it comprises 30 species and 12 varieties and forms new to science aside from the 46 species and 14 varieties and forms already described by the same authors in previous publications, the 79 species named by Peck, Murrill and a few other American mycologists, and the 62 species and one variety previously known in Europe and occurring in North America. A few entities reported from the West Indies and Mexico are included. Although the sampling in Canada was made only in

Nova Scotia and Southern Ontario, this contribution covers probably most of the species of this genus occurring in our country, and will be very useful for the education of new forms, varieties or species that may be encountered in our extensive territory.

To summarize, this comprehensive book is a noteworthy enrichment of the North American literature on fleshy fungi and many more monographs of this quality should be available. It is most regrettable that in such publications, the high cost of plates usually prevent the incorporation of full-color illustrations.

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**Introduction to Herpetology**

By COLEMAN J. GOIN and OLIVE B. GOIN. W. H. Freeman and Company, San Francisco 4, Calif. 1962. 341 pages, 114 illustrations, $8.00.

This book fills a longstanding gap on bookshelves dealing with amphibians and reptiles. Previous books on herptiles have consisted chiefly of field guides or natural history accounts and usually dealt with only one special group, such as salamanders. A tremendous amount of data has been brought together between the covers of this volume, and for the first time the reader is offered a world-wide perspective of these two important classes of vertebrates. What reptiles and amphibians lack in numbers of species they make up in numbers of individuals and as their prime food is insects and rodents their importance to man is obvious, although it remains unsung.

The book is meant to serve as a lecture text in formal courses of herpetology, but is aimed at students who have had only one course in biology. It is therefore admirably suited for any well read amateur naturalist. The authors first discuss the basic principles of classification and how these apply to the amphibians and reptiles. There follows a history of the science of herpetology. Four chapters outline the anatomy and evolution of the two groups and this is followed by six chapters on natural history, speciation and geographic distribution. The final six chapters are devoted to a description of and life history notes on the families of living amphibians and reptiles. Appendix A is a classification table of all living and extinct herptiles down to family and Appendix B is an interesting tabulation of the chromosome numbers for 132 species.

To this reviewer, the book fell short of expectations. There is a paucity of anatomical illustrations and the anatomy references are chiefly standard comparative anatomy texts. It is disappointing that more use was not made of original papers in the literature especially on such topics as the ear of amphibia and the nasal region of reptiles. In fact, rarely in this "Introduction" text is reference made to what are truly classic papers in herpetology. The addition of a few such references at the end of each chapter would have doubled the value of the book without raising its price. Instead, the student is introduced to the old texts and is left unaware of the fascinating frontiers in taxomonic methods, behavior, minicry, homing, voice, postglacial dispersal and population structure being explored today by a host of prominent researchers.

Several minor irritations were noted including the use of metric system throughout without any reference to the equivalents in pounds and inches. Such expressions as "other turtles" and "certain snakes" seem inexcusable in a text on herpetology where one expects to learn precisely *which* genera or species have this or do that. It is hoped that the teleological statement on page 34 was an oversight on the part of the authors for no student should be told simply that in order to cope with the complexities of the terrestrial environment the higher vertebrates developed a more complicated nervous system.

"Introduction to Herpetology" is a fine summary of the history of herpetol-

ogy, the anatomy, evolution, ecology, speciation, distribution and classification of the amphibians and reptiles, and will be greatly appreciated by both professional and amateur naturalists.

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**Ichthyology**

By LAGLER, KARL F., JOHN E. BARDACH, and ROBERT R. MILLER. John Wiley and Sons Inc., New York, 1962, 549 pp., illus. $12.50.

This is the first textbook on ichthyology to appear in several decades. It includes a wide range of information and is well illustrated, printed, bound and indexed. Fortunately, the current trend towards use of glossy paper has not been followed.

Chapters include: classification, basic fish anatomy, skin, food and growth, skeleton and movement, circulation, respiration, excretion and osmotic regulation, reproduction, integration (nervous and endocrine systems), genetics and evolution, systematics and nomenclature, ecology and zoogeography. The sections are well cross-indexed. A sparse selection of references is given at the end of each chapter.

There is an unevenness in the treatment of chapters, some being oversimplified. The classification outline unfortunately does not include all the families. The lancelets are not included, although both Jordan and Berg place them in their classifications. The discussion of fossil and living fishes separately does not give the student an integrated picture of evolution. Space is wasted through duplication in the basic anatomy and later chapters. Technical terms being introduced are hidden between parentheses instead of being emphasized in boldface type or italics. Only the external elements of the skull are presented and behavior is curtly dealt with. The sections on the brain and zoogeography are good. Few of the illustrations are original.

The elimination of duplication, of the limnological-oceanographic section, of unnecessary background material which should be obtained in introductory zoology courses and of commonplaces such as "Fish, as all animals require adequate nutrition in order to grow", and "The most characteristic movements of fish are for swimming", would give space for more detailed information for the serious and intelligent student.

There is a pandering towards popularization and simplification which is not desirable in a text. Popular names for fishes are used excessively and coined where none exist. The spinules on scales are called "teeth" rather than ctenii. Colloquialisms such as . . . "juicy contributions of the sperm ducts". "Fishes, with amphibians and reptiles are cold-blooded poikilothermous vertebrates", and "adhesive stickiness", mar the text. Evolution is referred to as a theory.

Errors and omissions are not very numerous but more could have been removed by having other ichthyologists check the text. Some errors and omissions may be mentioned. The first sentence, a definition of fish, does not eliminate gilled salamanders. No trouble has been taken by the authors to bring the classification to date. Neostethidae are not currently recognized as distinct from Phallostethidae, nor the Gasteropelecidae from the Characidae. The new order Miripinnati is not mentioned. The axillary appendages function to streamline the adducted paired fins. Some Actinopterygii (Acipenseridae) do have a spiracle. A third eye pigment is known in fishes. Catostomidae are not indicated on Cape Breton Island, Nova Scotia. The term antitropical is not mentioned in the zoogeographic section.

However, despite the above problems the book does present the basic background for an introductory ichthyology course.

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**Ma-Kee: The life and death of a muskellunge**

BY DAVID V. REDDICK. McClelland and Stewart Ltd., Toronto. 1963. 206 pp., 15 line cuts. $5.50.

This book, as the subtitle implies, deals with the life story of a muskellunge in the Kawartha Lakes area of Ontario starting with the spawning and death of its mother to the final demise of the "heroine" of the story. The reader is carried, by a series of chapters, through the triumphs and tribulations met by this muskellunge during its life. Many of the chapters such as: Water Tiger, Ravenor, Trapped, The Man-threat and Hope, in name, plot and style are reminiscent of the serial suspense of the "Perils of Pauline", the Saturday movie serials of the thirties or the soap operas of radio fame.

The author has an interesting story to tell and the ability and experience to do so. He falls deeply, however, into the pitfall of anthropomorphism. We are told of the "sagacious cunning with which her kind is endowed" of how she "practises" at killing, of her "zest for the kill", how she "feels upset" and "indisposed" etc. In the latter half of the book where the author deals with people and their association with fishes he is much more at home, the book reads well, is true to life, amusing and interesting.

The story introduces other fishes in the environment, research projects which have attempted to learn more about the "dwindling muskellunge" and a broad panorama of outdoor sights and sounds. Most anglers and outdoorsmen will enjoy the story. The well-informed angler and naturalist who have some background knowledge about fishes will recognize some of the many technical errors. A representative of the publisher stated, during its production, that the book was fiction and therefore did not require expert editing. The errors involved, such as the capabilities of a muskellunge, the theory of aging fish, the naming and spelling of names of the fishes referred to, etc., could easily have been avoided by having had the manuscript read by anyone of many people available to the author.

The author brought to the story not only his wide experience with the outdoors as angler and hunter, but also his opportunity to learn the more technical side of the muskellunge story during his association with the research project which enters the story. The errors are probably attributable to his dependence on memory for the technical aspects. The quality of the writing varies. There are enjoyable, well turned passages such as "like the strings of a tilted harp, awaiting the strumming that only fish-mouths could give them, the [anglers'] lines stretched taught from dam to water". In contrast there are passages where the author pontificates, as with the propounding (in italics) of the "law of the marsh".

To those who enjoy fishing, know something of Canada's most outstanding freshwater angling prize and who are not bothered by anthropomorphism, Ma-Kee will provide an enjoyable evening's reading.

E. J. CROSSMAN.
Royal Ontario Museum,
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Toronto, Ontario.

# NOTES

## *Kalmia polifolia*: Second Record from the Arctic

According to Dr. Polunin, in his *Circumpolar Arctic Flora* (1959), "*Kalmia polifolia* . . . just qualifies for admission to the arctic flora on the basis of a single collection from the southeastern portion of the Canadian Western Arctic." The Güssow collection cited by Polunin is in the Phanerogamic Hebarium of the Canada Department of Agriculture. W. J. Cody, curator of the herbarium, informs me that it was obtained in 1932 at Maguse Lake (61° 30′ N, 95° 10′ W), which is about fifty miles northwest of Eskimo Point on the western shore of Hudson Bay. This locality is about twenty-five miles beyond the tree line. During August 1962 I collected *Kalmia polifolia* at Contwoyto Lake (65° 45′ N, 111° 15′ W) in the Barren Grounds some 200 miles east of Great Bear Lake and nearly fifty miles beyond the tree line. This collection, my number *9415*, is apparently the second record of *Kalmia polifolia* from the arctic. Specimens have been deposited in the herbaria of the University of Southwestern Louisiana and the Chicago Natural History Museum.

John W. Thieret

Department of Biology
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Lafayette, Louisiana
21 December 1962

## Forster's "Hirundo, 35"

In a paper read at a meeting of the Royal Society of London nearly two centuries ago Forster (1772, Philosophical Transactions of London, vol. 62, p. 408), reporting on specimens and information sent from Hudson Bay, made the following remarks under the subheading "Hirundo, 35" and pertaining, geographically, to Severn River,–

"The swallows build under the windows, and on the face of steep banks of the river, they disappear in autumn; and the Indians say they were never found torpid under water, probably because they have no large nets to fish with under the ice. The specimen sent answers in some particulars to the description of the Matrin, Hirundo Urbica, Linn., but seems to be smaller, and has no white on the rump. I have, therefore, thought it best to leave the species undetermined, till further informations are received from Hudson's Bay, on this subject".

Practically nothing was known about swallows in Forster's day, especially those of the New World. This is not surprising. Even today one would find it difficult to prove that swallows do, or do not, migrate at night. Forster showed commendable scientific caution in leaving his swallow specimen undetermined.

By the opening of the present century a good deal of information on American swallows had accumulated. At this time we have the comments of Preble (1902, North American Fauna, no. 22, p. 123) under the subheading Petrochelidon lunifrons (Say). Cliff Swallow,—"Forster recorded a specimen sent from Severn River as *Hirundo* no. 35. This is probably the earliest notice of the species, which was not formally described until many years afterward."

Ridgway (1904, Bulletin of the United States National Museum 50, p. 48) followed Preble and placed Forster's "Hirundo, 35" first (earliest) among his synonyms of *Petrochelidon lunifrons lunifrons* (Say). Authors have followed this interpretation since, without question, but what seems to be a shadow of doubt appears in the comments of Manning (1952, National Museum of Canada Bulletin 125, p. 71) under the subcaption *Petrochelidon pyrrhonota pyrrhonota* (Vieillot) as follows,–"A swallow briefly described by Forster, who says that they built under the windows at Fort Severn and on the face of the steep banks of the river, appears to be this species".

Preble's knowledge of swallows was much greater than Forster's. The Cliff (or Eave) Swallow had been described by his time and Preble knew it occurred far to the north, at least in the west; that it nested on the sides of buildings, quite possibly under a window if it were high up; that it nested on steep cliffs, if they were rock. His knowledge additional to that of Forster allowed him to conclude, wrongly, that "Hirundo, no. 35" was the Cliff (or Eave) Swallow. Preble's shortcomings apparently were a lack of familiarity with Old World "Martins"); no knowledge of the fact that there are no rock cliffs, at least on the lower half of the Severn; and no thought that the Tree Swallow will nest in crevices of buildings.

The writer contends that Forster presented information not on one, but on *two* species of swallows (the two most likely for the region). First, the Tree Swallow, *Iridoprocne bicolor* (Vieillot) (or whatever synonym the reader prefers) of which he had a specimen. Forster considered the specimen (quite understandably) a counterpart of the House Martin, *Delichon urbica* (Linnaeus) (or whatever synonym the reader prefers), except that it lacked the white rump. We could scarcely expect him to know about lightly feathered feet and the size discrepancy he noted is unimportant since his specimen was a dried skin. Second, Forster's information also pertained to the Bank Swallow, *Riparia riparia* (Linnaeus). It certainly nested on the steep, soil cut-banks of the Severn. Reference to "observations on Hudson's Bay", believed to be those of Andrew Graham, only about ten years later (1782) reveals that the "Martin [in this case the Sand Martin = Bank Swallow] . . . resorts hither in the beginning of June, harbours about the steep banks of rivers, where it breeds in holes, making a slight nest of straw and feathers, and lays five white eggs". No statement could be more lucid or helpful in diagnosis. It is worth quoting him further,—"I have interrogated the natives who reside here, also those inland, concerning the swallows being found torpid under water, but to no purpose; indeed they laugh at my question". (Quotations by permission of the Hudson's Bay Company, London.)

It is obvious then that there is no basis for considering "Hirundo, 35" to be a synonym of *Petrochelidon pyrrhonota pyrrhonota* (Vieillot). The first person to report the Cliff Swallow from Ontario was Charles Fothergill, that remarkable person introduced to us by Baillie (1944, Canadian Historical Review 25: 376-96). On June 29, 1835, Fothergill described this swallow in his diary (MS, Clendenan vol., ROM, p. 397) under the names White-faced, or Tawny-rumped Swallow. The first person to prove occurrence of the species on the Severn River, specifically at Fort Severn, was the late C. E. Hope, on an ROM survey. His field notes for July 2, 1940 state,—"Cliff Swallow (3) noted about the Post buildings today; appeared to be looking for nesting sites as they kept investigating up under the cornice". An Indian boy brought him a specimen that day. It is ROM no. 66, 386, an adult female. The writer regards this specimen as a representative of the subspecies *P. p. hypopolia* (Oberholster) which is generally paler, somewhat colder in colour, and averages larger. This record makes an eastern salient in the summer dispersal of the western form into Ontario from Manitoba.

L. L. SNYDER

Royal Ontario Museum
University of Toronto
Toronto, Ontario
8 March 1963

## Further Records of the Ross' Goose in Ontario

F. G. COOCH (1954, Condor 56 (5): 307) obtained a specimen of an adult female Ross' goose, *Chen rossii*, in 1953 and reported that two more were killed by an Indian in 1939 at the mouth of the Harricanaw River at the southern end of James Bay. He also reported (1955, Condor 57 (3)): that another specimen was shot at Hannah Bay in May, 1954.

He stated that the Indians of that area have no name for this species. These were the first records of Ross' geese in Ontario.

On September 22, 1962 at Fort Severn, Ontario, Conservation Officer C. Monk told the writer that he thought that a Ross' Goose had been shot by a hunter and taken out to Big Trout Lake that day. Mr. Fred Close of the Hudson's Bay Company kindly radioed to Big Trout Lake to ask if the specimen could be preserved. The bird was already prepared for the table but Mr. John Heglan saved the head and feet.

During the next week three more specimens were shot by visiting hunters at Fort Severn. One was cooked and eaten before any parts could be preserved. Another shot on September 24 was also cooked before Mr. Monk heard about it. He was given the carcass from which a partial skeleton has been preserved.

The fourth, a female shot by Dr. John Arouni on September 23 was given in the flesh to Mr. Monk.

The pure white plumage of two of these specimens indicates that they were not juveniles. The third from which the partial skeleton was saved had recovered from a severe wound. At some time the posterior third of the sternum had been fractured and had knit in a slightly offset position. This bird was in good flesh when killed. It is likely that it also was either an adult or a subadult. These specimens are now in the Royal Ontario Museum of Zoology and Palaeontology.

During the fall of 1961 at least two Ross' Geese were shot at Fort Severn, one by Mr. Fred Close and one by Mr. M. Koostachin.

There is a further sight record of Ross' Geese in northern Ontario. Mr. D. H. Johnston, who became familiar with Ross' Geese at Eskimo Point, N.W.T., where he handled and banded specimens, told the writer that he saw two on June 22, 1961. He was travelling in a canoe on the Bug River at 53°42′N, 90°06′W near Big Trout Lake when he passed within sixty feet of the birds as they sat on the water.

C. D. MacInnes and F. G. Cooch (1963, Auk 80 (1): 77-79) have suggested that a very small population of Ross' Geese has always been present in the eastern Arctic. This is supported by the fact that the Indians at Fort Severn know the species well and have a name for it that is not derived from their name for the lesser snow goose—"Wha-ho". (The interior Indians call lesser snow geese—"wa-wa".) To the Fort Severn Indians the Ross' goose is "Kaskanashish". They say that it is rare at Fort Severn but one or two are seen nearly every year and are occasionally shot.

H. G. LUMSDEN

Ontario Department of Land and Forests
Maple, Ontario
22 February 1963

## First Record of the Blue-spotted Salamander from Cape Breton Island, Nova Scotia

DURING THE SUMMER OF 1962 one of us (AMR) made a collection of reptiles and amphibians from the Maritime Provinces for the National Museum of Canada. Among the specimens obtained was a salamander of the *Ambystoma jeffersonianum* complex taken on May 31 in one of the archaeological excavations at the Fortress of Louisbourg, Cape Breton Island.

The salamander (NMC 6855) is an adult female, black above and grey underneath. In the preserved specimen there is no trace of blue spotting or flecking. Body length, snout to middle of the vent, measured before preservation was 64 mm. After preservation the specimen measures 66 mm, snout to posterior angle of the vent. Total length is 110 mm, but the tail tip is missing. There are 14 costal grooves on each side (counted by the method standardized for *Plethodon* by Highton, 1957, Copeia (2)): 107-109). The variation on mainland Nova Scotia is unknown but a series from Prince

Edward Island (Cook, 1961, *An analysis of the herpetofauna of Prince Edward Island*. Unpublished M.Sc. Thesis, Acadia University) has a range of 62 to 71 mm. for snout to mid-vent measurements of nine female *Ambystoma laterale*. Remeasurement of this series from snout to posterior angle of vent gives a range of 60 to 70 mm. (the difference of results is attributable to shrinkage after preservation). The Cape Breton specimen falls within the *A. laterale* size range whichever measuring technique is used. It also agrees in costal grooves and ground color. The absence of blue markings in preservation has been noted in a few Prince Edward Island specimens (Cook *op. cit.*).

The identification of Prince Edward Island material as *Ambystoma laterale* has been confirmed by T. M. Uzzell, Jr. (1962, *Morphology and biology of the Ambystoma jeffersonianum complex*. Unpublished Ph.D. Thesis. University of Michigan), who also established that the other and larger species in the complex, *Ambystoma jeffersonianum*, is not known to range into Canada.

The possibility exists that this specimen might be an example of the "megacytic" female hybrid form which occurs in some populations of this complex (Uzzell, 1962 *op. cit.*; 1963, Science 139 (3550): 113-114). Megacytic females can only be distinguished from normal females by erythrocyte size, chromosome number or egg count. The first two methods are not possible in preserved specimens and this example does not contain eggs. Its size, well within the normal range for *A. laterale* (megacytic females are often larger than normal *A. laterale* females), and the fact that megacytic females have not been reported from the Maritime Provinces (Uzzell, 1962) supports the probability that it is a normal female.

Although known from New Brunswick, Prince Edward Island and mainland Nova Scotia, the *Ambystoma jeffersonianum* complex had not been collected previously on Cape Breton Island (Bleakney, 1958, National Museum of Canada Bulletin 155; Logier and Toner, 1961, Royal Ontario Museum, Life Sciences Division, Contribution 53). The apparent absence of the species on Cape Breton Island is now shown to be due to inadequate field work and has no zoogeographic significance. It was the only species of the twelve herptiles established as occurring on Prince Edward Island (Cook *op. cit.*) that had not previously been recorded from Cape Breton Island.

FRANCIS R. COOK
ANNE MEACHEM RICK

National Museum of Canada
Ottawa, Ontario
25 March 1963

## Sight Record of Two Palm Warblers on Vancouver Island, British Columbia

ON JANUARY 12, 1963, the writers, while on a rough field near the Sidney Airport, Victoria, British Columbia, noticed three birds very active on the grass and low bushes. They rarely came into view, but one was larger and it was soon identified as a Lincoln Sparrow. The other two were unknown to us, however, so we followed them around the field until we saw them several times, and then wrote down a detailed description. They were warblers, bobbed their tails continually, and had yellow on the under tail coverts. On arriving home we checked with the books and found them to be Palm Warblers, *Dendroica palmarum*. We took our description to the Provincial Museum, and the biologist, Mr. C. J. Guiguet, confirmed our identification.

As far as we can ascertain, this is the first time the Palm Warbler has been seen on Vancouver Island. There is a specimen record for Vancouver (Law. 1950. Canadian Field-Naturalist 64: 93-94) and a sight record for Point Roberts, Washington (Erskine. 1960. Murrelet 41: 9).

ELEANOR DAVIDSON
ALBERT R. DAVIDSON

825 Monterey Avenue
Victoria, B.C.
18 January 1963

## Studies of the Byron Bog in Southwestern Ontario XV. Distribution of Some Fungi in the Bog

IN THE DESCRIPTION of the Byron Bog (W. W. Judd, 1957, Canadian Entomologist, 89: 235-238) it was pointed out that there are three zones in the area. These zones are designated as A, B and C on the map accompanying the description and their outer limits are shown on the map. Zone A is the central floating bog based on a mat of *Sphagnum* moss and covered almost completely by Leather-leaf, *Chamaedaphne calyculata*. Zone B is a low, wooded region, permanently damp or flooded, with hardwood trees and shrubs at its outer limits and Black Spruce and Larch at its inner limits. Zone C consists of wooded slopes occupied by deciduous trees and shrubs.

On September 16, 1962 a collection of fungi was made in the bog. Agaricaceae, Lycoperdaceae and Sclerodermataceae were identified by J. W. Groves, Head, Mycology Section, Plant Research Institute, Canada Department of Agriculture, Ottawa, Polyporaceae by Ruth Macrae and Thelephoraceae by Luella K. Weresub, also of the Mycology Section. All specimens have been deposited in the collection of the Mycology Section. The three zones (A, B, C) in which the various species were collected are noted in the following account.

Thelephoraceae

*Thelephora intybacea* Fr.—on dead twigs on moss: B.

*Stereum ostrea* (Blume and Nees ex Fr.) Fr.—on log on ground: C.

Polyporaceae

*Polyporus tulipiferae* (Schw.) Overh.—on trunk of Alder-Buckthorn, *Rhamnus Frangula*: B.

*Polyporus versicolor* L. ex Fr.—on log of Red Oak, *Quercus rubra*: B; on log of Hop Hornbeam, *Ostrya virginiana*: C.

*Polyporus conchifer* (Schw.) Fr.—on trunk of dead White Elm, *Ulmus americana*: B.

*Polyporus semipileatus* Peck—on dead branch on ground: B.

*Polyporus betulinus* Bull. ex Fr.—on dead branch on ground: B.

*Daedalea confragosa* Bolt. ex Fr.—on trunk of dead Alder-Buckthorn, *Rhamnus Frangula*: B.

*Fomes roseus* (Alb. and Schw. ex Fr.) Cooke—on end of sawn log on ground: B.

*Ganoderma lucidum* (Leys.) Karst.—on dead stump: C.

*Ganoderma applanatum* (Pers.) Pat.—on side of dead stump: C.

Agaricaceae

*Amanitopsis fulva* (Fr.) Fayod.—on soil in woods: B.

*Cortinarius subcinnamomeus* Clel.—in *Sphagnum* moss: A.

*Flammula alnicola* (Fr.) Kummer—on rotting stump: B.

*Flammula sapinea* Fr.—on rotting log of White Birch, *Betula papyrifera*: B.

*Cystoderma granulosum* (Batsch. ex Fr.) Fayod.—on soil among needles of White Pine, *Pinus Strobus*: B.

*Clitocybe clavipes* (Pers. ex Fr.) Kummer—on soil among needles of White Pine, *Pinus Strobus*: B.

*Lepista nuda* (Bull. ex Fr.) W. G. Smith—on soil in woods: B.

Lycoperdaceae

*Lycoperdon peckii* Morg.—common on soil in woods: B.

*Calvatia craniiformis* (Schw.) Fr.—on soil in woods: B.

Sclerodermataceae

*Scleroderma arenicola* Zeller—on soil: C.

Most of the species collected were found in the lower, damp, wooded zone (B) on soil and on logs and stumps. A few were found on soil and logs on the wooded slopes (C) and only one, *Cortinarius subcinnamomeus*, was found on the *Sphagnum* mat in the open bog (A).

WILLIAM W. JUDD

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University of Western Ontario,
London, Ontario
21 March 1963

## A Coastal Record of the Gopher Snake (*Pituophis*)

ONLY ONE INSTANCE of the gopher snake (*Pituophis*) occurring in Canada west of the Coast Range is recorded by Logier and Toner in their *Check List of the Amphibians and Reptiles of Canada and Alaska* (1961, Royal Ontario Museum, Life Sciences Division, Contribution 53, p. 77) and this is based on an early record by J. K. Lord (1866, *Naturalist in British Columbia* Vol. 2, p. 307). The recent finding of another specimen, this one on Galiano (one of the Gulf Islands) is therefore of considerable interest.

The gopher snake in question was collected by the late Dr. A. I. Ortenburger, a herpetologist living in retirement on Galiano Island. As his untimely death prevented him from completing a note for publication the writer has undertaken this small task for him. A son, Mr. Robert D. Ortenburger of Tulsa, Oklahoma, has kindly deposited the specimen and rough notes at the Provincial Museum in Victoria.

The specimen is a male and is partly skinned, the skin having been slit ventrally along the mid-line from a point near the twenty-eighth ventral shield to a point just forward of the anus. The trunk of this region has been removed but otherwise the specimen is intact except for two breaks on the ventral surface of the tail.

The accompanying label reads in part "*Pituophis catenifer*, Galiano Island, B.C. On road 4 mi. N.W. of Government Wharf, July, 1957." The following measurements are mostly from pencilled notes by Dr. Ortenburger.

Total length: 880 mm.
Trunk length: 781 mm.
Ventral scales: 212
Caudal scales: 45 (tail incomplete?)
Scale rows: 29-31-21
Infralabials: 11 L, 12 R
Dorsal trunk spots: 77
Dorsal tail spots: 29
Total dorsal spots: 106
Spots 4 scales or less in length.

In number of scales and in number of dorsal spots the Galiano Island specimen falls within the range of variation of subspecies *catenifer* as given by Klauber (1947, Zoological Society of San Diego Bulletin 22). However, the colour pattern differs from that of typical *catenifer* in a few minor details. The anterior blotches are dark brown as described but they are not well defined. In addition to the alternating auxiliary blotches in four series on each side, there are several isolated spots near the mid-line on the ventral surface, a feature not noted by Klauber. Furthermore, there is no indication of the grayish suffusion on the body or on the underside of the tail which Klauber states is characteristic of *catenifer*. Despite these slight differences in colour and colour pattern the specimen seems to be more closely allied to *P. melanoleucus catenifer* than to *P. m. deserticola*, the subspecies to which coastal snakes were provisionally assigned. Obviously, it is desirable to have more specimens for study before the question can be settled satisfactorily.

Dr. Ortenburger was indebted to Dr. Doris Cochran of the United States National Museum, Washington, D.C., for advice and references. The specimen was originally intended for deposition in The Museum of the University of Oklahoma but Dr. Carl D. Riggs, Director, has kindly turned it over to the Provincial Museum at Victoria, B.C., where it now bears the Catalogue Number 944.

G. CLIFFORD CARL

Provincial Museum
Victoria, B.C.
13 January 1963

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## Articles



## Reviews



## Notes



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# THE FUNGUS RECORDS OF MR. H. A. C. JACKSON FROM L'ISLET CO., QUEBEC

1941-1960*

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THE DEATH OF Henry A. C. Jackson in his eighty-fourth year removed one of Canada's outstanding amateur naturalists. He was especially noted for his knowledge of the fleshy fungi and our native birds but his interests ranged over all fields of natural history. A commercial artist by profession, he turned his artistic talents to the fungi as a hobby and left a collection of approximately one hundred magnificent paintings of higher fungi that have never been surpassed in their combination of artistic beauty and scientific accuracy. Some of these paintings were on exhibition at the Montreal Art Gallery during the Ninth International Botanical Congress in 1959, and they have also been shown at meetings of the American Mycological Society.

Mr. Jackson was born in Montreal on August 25, 1877, and was the eldest of a family of four boys and two girls. He obtained his schooling in Montreal but circumstances forced him at an early age to accept responsibility for the support of the rest of the family. After brief periods of employment in Philadelphia and Ottawa and a trip to Europe made by cattle boat with his younger brother Alex (A. Y.) in 1905, when they spent several weeks visiting museums and art galleries, he joined a lithographing firm and eventually attained distinction in this profession where he was recognized as an authority in his field. In 1909 he married Coralie Adair and they took up residence in Montreal where they lived until 1957 when they moved to Manotick, near Ottawa.

He is survived by his wife, Coralie, three daughters, Naomi (Mrs. J. W. Groves, Ottawa), Geneva (Mrs. A. E. H. Petrie, Montreal), and Constance (Mrs. R. A. Hamilton, Manotick); two brothers, Alex (Ottawa, noted Canadian landscape painter and member of the Group of Seven), and Ernest (Lethbridge, Alberta); and one sister, Catherine (Rawdon, Quebec).

He retired from commercial life in 1940 and built a summer home near St. Aubert, L'Islet Co., Que. The Jackson family first visited friends there in 1931, fell in love with the place, and have been going back for part of each year ever since. At that time he carried on a correspondence with Dr. John Dearness of London, Ontario, the veteran Canadian mycologist, then around ninety years of age. After the death of Dr. Dearness in 1953 in his one hundred and third year the letters were returned to Mr. Jackson. The first begins with an appreciation of Dr. Dearness' kindly understanding of "what the hopes and

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joys of a mushroom hunter mean". Almost all the subsequent letters deal with these "hopes and joys" as experienced in the neighborhood of St. Aubert in the hills behind St. Jean Port Joli on the lower St. Lawrence.

Referred to variously as 'Elgin Road' which passes nearby on its way southward from the river to the Maine boundary, as 'St. Aubert' from the village four miles to the west, and as 'Patly Hill' from the name by which the Jackson women like to refer to it, this country place brought Mr. Jackson great happiness during the entire last quarter of his life. Selections from these letters to Dr. Dearness help to recall that happy time and speak eloquently of his love for the countryside and nature.

* * *

*September 27, 1938*

. . . We have acquired a piece of property in L'Islet County about 65 miles below Quebec on the South Shore. About seven acres on a ridge nearly six hundred feet above the St. Lawrence and five miles back. About three acres of our land is in forest. Beautiful mixed woods with high outcroppings of rock. At the rear some nice meadowland with a trout stream running through it. Yes, and I must not forget to tell you: good mushroom collecting in the woods . . .

*October 25, 1939*

. . . Well to make a long story short [Mr. Jackson's eyesight had suffered from a fall in the previous winter and the doctor had recommended a long holiday] I spent the happiest summer of my life. The first time I had enjoyed a real vacation with my entire family. Blue distance and green foliage were like balm to my eyes and they improved immediately. This is a little rough sketch of our house. [Sketch of house from the east]. The view we get is inspiring. Looking north the farmlands are spread out like a map at our feet with little spruce-clad ridges scattered through them. Then the great river, 17 miles wide, with the big North Shore hills rising three thousand feet sheer from the water and going back range upon range to the horizon.

Then there are other attractions, woods in every direction and only a few minutes walk away, largely black spruce and sugar maple, hills and valleys. Needless to say the collecting will keep a man busy forever. Besides fungi a great orchid and rare fern country.

Next summer I am hoping to break away from my soulless business for at least six months. My mycological work did not make the hoped-for progress. Building operations were disturbing and I had no place to settle quietly and work on the material collected. Next year that will be rectified as I have a lovely little room all of my own in the garage building, away from the restrictions of my womenfolk where I can be as untidy as I please!

Collecting in this immediate region has not been up to former years. Still there is always something to see. When the fungi are scarce there are always the migrating birds to observe. . .

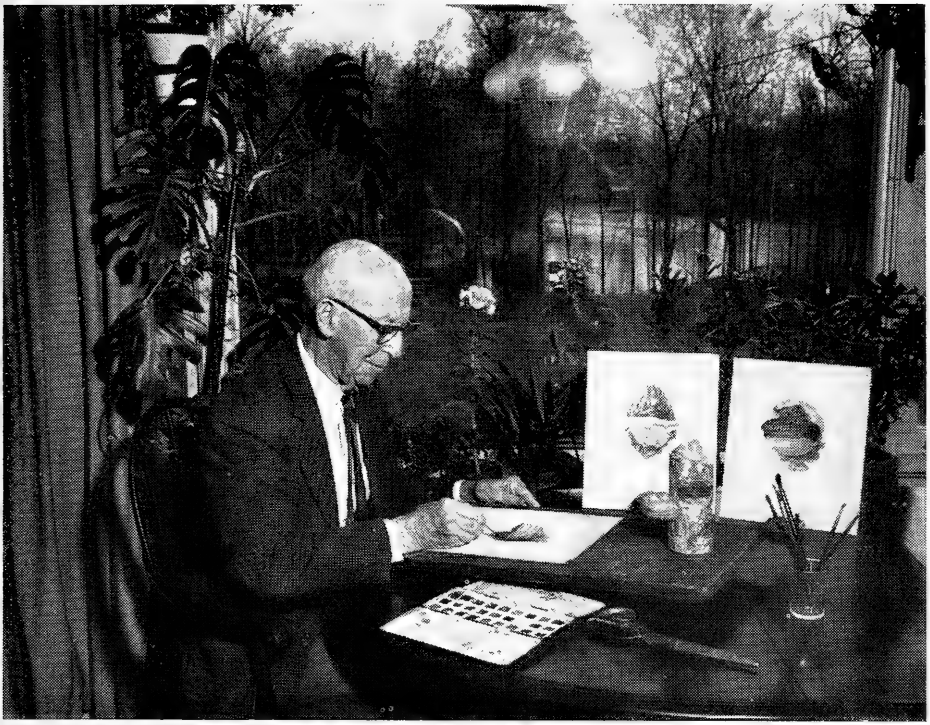

FIGURE 1. H. A. C. Jackson in his home at Manotick, Ontario in 1960.

*December 19, 1939*

. . . I am glad you liked my description of our summer home. I am so enthusiastic about it that my wife cautions me lest I become an absolute bore. Anyway I cannot help it; by day and in my dreams at night I am thinking about it. An untapped region with interesting treasures at my doorstep. What lies beyond I hope in time to find out. A mere instance — a hundred yards from our house on the hill is a stand of *Corallorhiza striata*. It keys out in all the manuals I possess. Marie-Victorin knows only four stations in Quebec. A mile away is a black spruce wood with many *Hydnum* growths. Some of them are still puzzling my friends in Ottawa, many forms are so local . . . In every direction there are intriguing stretches of woodland to be quartered over at my leisure.

. . . my little lab will be a complete unit, even to containing a couch and small stove, a drawing table, bookshelves, cupboards, etc. Far enough from the house to be uninterrupted and I can sleep there when I care to and probably will very often.

. . . . There is a long winter ahead. . . But the weeks will be ticked off till the month of May when I hope to go back to L'Islet County. In the meantime there will be various expeditions with members of the Bird Society to observe

life in the winter woods. Our secretary is in the Army and I have the job of organizing the Christmas Bird Census.

*July 29, 1940*

. . . With my wife and three daughters I have been here five weeks. By contrast to the exacting toil of the last forty-nine years, life is a pleasant dream and I have a feeling of guilt and fear lest there be an awakening. We are pretty well established and I have my own sanctum in the hangar. Never was there more comfort and convenience and less interference. A six foot table to work on and a six foot window in front of it. Lifting up my eyes as I write this is what I see. The mountains are thirty miles away . . . A region of vast distances. After being under pressure so long one has to fight an inclination to take things too easily. To keep active I went, Sunday a week ago, to Mass at St. Aubert. Then through the week I made three drawings, two of them of Ravenel's Stinkhorn (something I could not have done at home). Several expeditions to the woods which are extremely dry. Then to ease my conscience I went yesterday to a little French Protestant church in the hills behind. The famous Father Chinoquay lived here many years ago and this little community are the descendants of converts he made among the French Canadians. It seemed strange that none of them could speak a word of English.

Nothing but French is spoken in this part of Canada and we have to adapt ourselves accordingly. We have been received with friendship and kindness by the whole countryside and have been made to feel that while we are of a different tongue and persuasion there will never be the slightest prejudice against us.

When crossing through the woods and fields, should I ever encounter the proprietors I always ask their permission. It is always given with the greatest surprise that such a request should be made. I am getting to be known as "l'homme avec le panier" and seem a mysterious person but they are all too polite to evince much curiosity.

The torrid weather has not bothered us much. While the heat may be fierce in the daytime there is always a cool breeze at night. We are about 115 miles north in latitude from Montreal and the large body of water no doubt tempers the climate. The summer season of course is very much shorter and it was strange to see lilacs and peonies out in the early part of July. The season affects the wild flora – *Cypripedium acaule* in bloom a full month later than around Montreal.

This is a good orchid country and I have had a lot of fun naturalizing colonies around my own woods or marshes. Started last year and most of them survived and are blooming this year, such as *Cypripediums*, *Habenarias*, *Epipactis* etc. It is interesting to see their development without having to range too far. Also I hate to let a wild flower pass without getting its history. Find Marie-Victorin's book invaluable here. All this Gulf region was his special hunting ground and he often gives the actual locations of anything unusual. This all adds to the joy of living.

the country. This just fell in with the plans of my family for we were building a little house in Gibbet County, about 70 miles below Quebec on the south shore of the St. Lawrence.

Well to make a long story short I spent the happiest summer of my life. The first time I had enjoyed a real vacation with my entire family. Blue distance and green foliage were like balm to my eyes and they improved immediately.


This is a little rough sketch of our house. It is five miles back from the river and about five hundred feet above it. The view we get is inspiring. The farmlands are spread out like a map at our feet, with little spruce clad ridges scattered through them. Then there is the great river, 17 miles

FIGURE 2. Facsimile of a page of a letter to Dr. Dearness, October 25, 1939, with a pen sketch of his summer home.

The Maine frontier is only a few miles back from here. With a map you will see how close it runs to the St. Lawrence. The country in the hinterland is all heavily wooded with hardly any settlement. On the U.S. side I believe it is nearly all forest reserve. I climbed a fire ranger's tower on the top of a ridge. Never saw so much standing timber with hardly a break anywhere, and mostly hardwood. Its preservation lies in the cost of getting it out which I believe is prohibitive.

The district here is largely a Black Spruce region. Through their inability to get supplies from Norway and Sweden, the U.S. is buying pulpwood largely from Canada and the Black Spruce is being felled everywhere. Many of my favourite hunting grounds have been laid low and the big peeled trunks lie like jack straws where used to be the forest primeval. . .

*October 1, 1941*

. . . The autumn is passing quickly here. Already the blaze of the maples is nearly over and many of them are bare. A few nights ago we had frost and we could see the summits of the big North Shore hills white with snow. . . .

*September 16, 1943*

. . . I came down at the beginning of May with my brother A. Y. who is an artist. At that time the snow banks were high and it was extremely interesting to watch the snow recede day by day under the increasing heat of the sunlight. There were patches though on the mountains on the North Shore till the middle of June. My brother found compositions to paint to his heart's content. This was a busy time for me also as I had an extensive garden to plant and much work about the house and grounds.

I think I described my "estate" once before. It comprises [with additions] some fifteen acres, mostly wooded with conifers, white pine, white and red spruce, balsam fir, and white cedar. Wild and craggy with cliffs and dales. Our house is situated on a hilltop in what used to be an ancient meadow. We built there for the superb view which can scarcely be equalled in this region. . . The country is spread out like a map at our feet . . . Just now the farmlands are like a checkerboard with the ripening crops. . . Can you wonder that I love it and am so enthusiastic?

All of the country around is a collector's paradise. There are wooded hills in every direction which I range within a radius of about three miles.

There have been abundant rains with great regularity nearly all summer and autumn and fungus growth has been at its absolute zenith. It is now necessary to carry one's largest basket and I can assure you that much more of my time has to be spent in the lab than afield.

As far as possible I am trying to keep a faithful record of all my collections. Of course much of the material I find is new to me and I can only do the best I can. Whenever possible I send my specimens to my good friends in Ottawa, also to Dr. Snell and Dr. Pomerleau. Also I dry and preserve as many as I can for my own herbarium. Would that I had one of your knowledge close at hand.

Have most of the good manuals on the fleshy fungi but not all. . . When I return to the city for the winter I will compile my records into complete form. . . If possible just now I would like to spend every minute mycologically and perhaps I show impatience when interrupted. However household duties must be carried on, eh?

The urge to draw is also sometimes a problem. I find so many subjects among my collections which I simply have to try and reproduce. Often it is a choice of making a drawing or letting a collection spoil. I usually choose the former on the chance that I may find similar specimens again. In many cases the drawing can only be made to do justice when the material is at its best. Sometimes one cannot work fast enough as the model shrivels. I believe that this was one of the reasons that Farlow's book took so long to produce. The difficulty of working with fresh specimens and having the drawings passed.

Speaking of Farlow's book have you ever noticed the beautiful reproduction of *Armillaria imperialis*? . . . That species has appeared here in great abundance in this wet season. I made a careful drawing of what I thought was a good specimen only to find some much finer and more fully opened. Then there was nothing to do but paint the best specimen of the many offered. This all took time but they make nice records.

Ten years ago here I collected *Scodellina auricula*. I made pencil sketches and colored them from notes. Dr. Seaver liked my drawings and said that he had never seen such perfect specimens. This year, only one day for it never appeared again, I made a large collection of the most gorgeous specimens. I drew six of them and put in every crack and wormhole.

These are just a few of the interesting records and there are many others. Were I only a wealthy man I would like to have the Mycological Society down here for a Foray and pay all their expenses. I think we could stage something as good as Duchesnay which was the best I was ever at. . .

The seasons in this latitude are all shorter, except winter, than in Ontario. Strange to say early frosts in autumn are not the rule. It may be that the broad St. Lawrence, which never freezes here, may temper the climate.

This is also a good apple region and some of my neighbours make a nice income out of their orchards. I have laid out nearly fifty trees and am going through the trials of inexperience, but it is a pleasant interest to take up.

My dearly beloved and ancient Honeyboy passed on in his fifteenth year and now Peter the pup reigns in his stead. Peter is the same type, a golden cocker. I dearly love to have a dog at my heels when in the woods. They are always so happy and filled with enthusiasm.

And still the war goes on. . . .

*December 30, 1943*

. . . . I think my interest in fungi is holding its own anyway. Last summer was possibly one of my best years as far as collecting went, likely on account of the evenly spaced rains. My handicap was lack of connection with my masters as well as a scientific background, and not the best of equipment. . . Nor was my brush altogether idle for I covered fifteen sheets. Of course I could have

done much better if all my time had been devoted to that instead of my many other commitments.

. . . . Am now living the lesser half of my "dual existence", the hibernation period. After my active life in L'Islet County it seems very quiet and all too easy. The last month and a half I was alone there with only Peter my dog for company. Through lack of local labour I had to cut my own firewood but enjoyed the burning thereof all the more. In four months time I hope to renew my contacts with Nature and all its interests. If fortune treats me as kindly next year as this I will be more than satisfied.

* * *

The yearly visits to St. Aubert continued for another seventeen years. In 1959 Mr. Jackson joined for one day with all his old enthusiasm, one of the mycological field trips of the Ninth International Botanical Congress that was being held in that region, but in the last two years of his life his strength gradually declined and he passed away quietly at his home in Manotick on July 2, 1961.

At the time of his death members of his family felt that a fitting memorial to him would be the publication of some aspect of his interest in natural history. Many friends assisted to make this possible. After considerable deliberation it was decided that because of his great interest in the fungi and the fact that he had already published his records from the Montreal area from 1930-1940 (1948, The Canadian Field-Naturalist 62: 127-133), the most suitable memorial would be the publication of his records for the following twenty years, 1941-1960, from his beloved St. Aubert.

He kept careful records of the species of fungi he observed each year, usually noting one date, presumably the first date on which he observed that particular species, although this cannot be true in every case because some records of the large perennial polypores are dated late in the season. He was well aware of the importance of preserving specimens but his facilities for doing so were extremely limited. His herbarium of some 700 specimens was purchased by the Plant Research Institute, Canada Department of Agriculture, after his death and the specimens have been deposited in the National Mycological Herbarium (DAOM). Other specimens have been deposited here also by J. W. Groves and I. L. Conners who have collected with him at St. Aubert.

The following list has been arranged in sections according to the groups of fungi. J. W. Groves compiled the list of Ascomycetes, Agaricaceae, Boletaceae, and Gasteromycetes,. and Ruth Macrae the list of Polyporaceae, Thelephoraceae, Hydnaceae, Clavariaceae, and Tremellales. In each group the species are listed with the DAOM accession number, the date of collection, and the initials of the person who made the determination if it was someone other than Mr. Jackson himself, and the number of times he recorded the species. By this is meant the number of years the species was recorded. If there are several collections in one year it is counted as one record.

At the end of each section is a list of species he recorded but of which no specimens were preserved, and the number in brackets following the species name is the number of years in which this species was recorded.

In the light of later knowledge some errors in identification undoubtedly occur. In many instances, however, these errors are the errors of the authors of the manuals he was using. Most of his material was identified correctly according to the manual he was using. He had a very critical approach to problems of identification, and although extremely modest about his own opinions, all the mycologists who were privileged to work with him in the field were deeply impressed by his careful observations and wide knowledge.

Where specimens have been preserved, errors in identification can eventually be corrected, but this is not possible where there are no specimens. Probably a high percentage of his unsupported determinations are correct but, especially in difficult genera such as *Russula*, *Cortinarius*, *Inocybe* etc., many of the records will have to remain doubtful, at least until these species are collected again in this area.

The initials used in the list refer to the following mycologists: AHS, Alexander H. Smith; CAL, Constance A. Loveland; FJS, Fred J. Seaver; HEB, Howard E. Bigelow; ILC, Ibra L. Conners; JWG, J. Walton Groves; KAH, Kenneth A. Harrison; HSJ, H. S. Jackson; Maas G., R. A. Maas Geesteranus; MKN, Mildred K. Nobles; OP, Olga Prodan; RM, Ruth Macrae; RP, Rene Pomerleau; RS, Rolf Singer; SCT, Sheila C. Thompson; WHS, Walter H. Snell.

## AGARICACEAE

*Agaricus arvensis* Fr. 59955, 30-8-58, JWG. 9 records but noted by HACJ that his early records confused this species and the robust form of *A. silvicola*.

*A. auricolor* Krieg. 61116, 30-8-58, JWG. 1 report.

*A. campestris* Fr. 56559, 3-8-57. 16 reports.

*A. diminutivus* Peck. 48528, 17-9-55; 56581, 30-7-57; 60268, 26-8-58, JWG. 11 reports.

*A. haemorrhoidarius* Fr. 87234, 3-9-41, WHS; 87356, 31-7-43; 56536, 30-7-57, JWG. 11 reports.

*A. micromegethus* Peck. 87119, 2-9-41, WHS. 2 reports.

*A. silvaticus* Fr. 56580, 15-9-57, JWG. 3 reports.

*A. silvicola* (Vitt.) Sacc. 64949, 9-9-59. Probably common but reports uncertain due to confusion with *A. arvensis*.

*A. xanthodermus* Genev. 16527, 13-9-45, JWG. 1 report.

*Amanita bisporigera* Atk. 87237, 24-9-55, RP. 1 report.

*A. brunnescens* Atk. 87236, 30-8-55, RP. Early records of this species were evidently confused with *A. mappa* and *A. phalloides*. From my own observations (JWG) I should consider this to be a common species in this region.

*A. flavoconia* Atk. 16904, 18-9-46, JWG; 29965, 4-9-58; 56576, 26-7-57; 64946, 6-9-59, JWG. 15 reports.

*A. gemmata* (Fr.) Gill. 21233, 7-7-47, RP; 56527, 26-7-57, JWG; 56589, 30-7-57, JWG. 6 reports.

*A. muscaria* Fr. 16856, 23-9-46. 20 reports.

*A. porphyria* (Alb. & Schw. ex Fr.) Secr. 60469, 28-8-58, JWG; 64947, 9-9-59, JWG; 87358, 29-8-45. 4 reports.

*A. rubescens* (Pers. ex Fr.) Gray. 16505, 20-7-45; 56359, 30-7-57; 60254, 26-8-58; 75617, 6-9-59, JWG. 17 reports.

*A. tomentella* Krombh. 16870, 17-9-46, JWG; 54240, 24-9-55, SCT; 56569, 1-8-57, JWG. 16 reports.

*A. virosa* Lam. ex Secr. 87238, 8-8-55. 9 reports.

*Amanitopsis albocreata* Atk. 84886, 6-8-55. 1 report.

*Armillaria dryina* Fr. 84887, 19-7-51. 1 report.

*A. focalis* Fr. 16867, 23-9-46, AHS. 1 report.

*A. imperialis* (Fr. in Lund) Quél. 16947, 27-9-46, AHS; 48483, 16-9-55; 64157, 7-9-59, JWG; 87239, 20-9-47, 87244, -10-44, JWG. 10 reports.

*A. mellea* (Vahl ex Fr.) Kummer. 16917, 17-9-46. 20 reports.

*A. ventricosa* Peck. 11479, -9-43; 16492, -9-45; 16804, 21-9-46, JWG; 16909, 18-9-46, WHS; 56570, 1-8-57, JWG; 56586, 31-8-57, JWG; 59973, 30-8-58, JWG; 87014, 3-10-49, AHS. 14 reports.

*Bolbitius fragilis* (L.) ex Fr. 84888, 10-8-52. 2 reports.

*Cantharellus cibarius* Fr. 16512, 6-9-45; 16916, 18-9-46, JWG. 20 reports.

*C. cinereus* Fr. 27217, 7-9-51, SCT. 2 reports.

*C. clavatus* Fr. 10568, 31-7-41, JWG; 56601, 3-8-57, JWG; 87242, 15-8-41, JWG. 14 reports.

*C. floccosus* Schw. 56565, 3-8-57, JWG; 87243, -8-40, 16508, 15-9-45. 15 reports.

*C. lutescens* Fr. 87124, 13-9-47. 1 report.

*C. multiplex* Underw. 27218, -9-51; 48514, 27-9-55; 64208, 7-9-59, JWG; 84893, 14-8-51; 87016, 22-9-51; 87017, 23-8-50. 6 reports.

*C. tubaeformis* Fr. 48469, 19-9-55; 48520, 17-9-55, JWG; 87123, 28-8-54, JWG; 87246, 20-9-55. 2 reports.

*C. umbonatus* Fr. 16905, 21-9-46, JWG; 29-9-45. 10 reports.

*Claudopus depluens* (Fr.) Gill. 16828, 19-9-46, JWG; 87126, 7-9-44. 4 reports.

*Clitocybe adirondackensis* (Peck) Sacc. 84546, 29-9-50; 87127, 28-8-54; 87362, 17-8-48. 7 reports.

*C. aurantiaca* (Fr.) Studer. 16793, 23-9-46, JWG. 18 reports.

*C. clavipes* (Pers. ex Fr.) Kummer. 48518, 14-9-55, JWG; 59938, 2-9-58, JWG. 18 reports.

*C. cyathiformis* (Bull. ex Fr.) Kummer. 87019, 9-9-51. 5 reports.

*C. dealbata* (Fr.) Kummer. 87021, 6-10-51. 9 reports.

*C. eccentrica* Peck. 46743, 4-6-55, SCT; 84898, 22-9-48; 88971, 7-9-50. 5 reports.

*C. ectypoides* (Peck) Sacc. 59931, 2-9-58, JWG; 87128, 23-9-47; 87364, 29-7-45. 6 reports.

*C. maxima* Fr. 88975, 13-9-45. 3 reports.

*C. multiceps* Peck. 87365, 15-9-45. 2 reports.

*C. odora* (Bull. ex Fr.) Kummer. 16520, 15-9-45; 16924, 17-9-46, JWG; 60229, 26-8-58, JWG; 87022, 18-9-41. 6 reports.

*C. parilis* (Fr.) Gill. 64909, 6-9-59, JWG. 1 report.

*C. subconnexa* Murr. 64912, 7-9-54, JWG. 1 report.

*C. tenuissima* Romagn. 64945, 6-9-59, JWG. 1 report.

*Clitopilus caespitosus* Peck 16753, 15-9-45, OP; 16954, 27-9-46, JWG; 87025, 20-9-50. 10 reports.

*C. orcellus* (Bull. ex Fr.) Kummer. 84899, 29-9-55; 84900, 15-9-49; 87370, 23-7-45. 13 reports.

*C. prunulus* (Scop. ex Fr.) Kummer 80238, 25-8-58, JWG. 9 reports.

*Clitopilus subplanus* Peck. 87129, 22-7-46. 1 report.

*C. undatus* Fr. 64167, 6-9-59, JWG. 1 report.

*C. woodianus* Peck. 48506, 17-9-55, JWG. 1 report.

*Collybia acervata* (Fr.) Gill. 16849, 23-9-46, JWG; 48463, 15-9-55, JWG; 60206, 28-8-58, JWG; 64113, 8-9-59, JWG; 87131, 24-8-54; 87132, -10-47. 9 reports.

*C. albipilata* Peck. 17126, 19-9-46, AHS; 17127, 26-9-46, AHS. 1 report.

*C. ambusta* (Fr.) Quél. 87130, 22-9-42, 1 report.

*C. aquosa* (Fr.) Kummer 16800, 25-9-46, HEB. 3 reports.

*C. butyracea* (Bull. ex Fr.) Kummer 16514, 17-9-45; 63335, 3-7-59, JWG. 14 reports.

*C. cirrhata* Fr. 16380, 15-9-45, JWG; 16839, 25-9-46, AHS. 13 reports.

*C. confluens* (Pers. ex Fr.) Kummer. 16795, 23-9-46; 60249, 29-8-58, JWG. 19 reports.

*C. cookei* (Fr.) Arnold 16815, 19-9-46, HEB. 1 report.

*C. familia* Peck. 48512, 27-9-55, SCT; 87133, 22-9-42. 4 reports.

*C. hariolorum* (Fr.) Quél. 87024, 10-7-51. 2 reports.

*C. leucocephaloides* (Peck) Sing. 16859, 21-9-46, JWG. 3 reports.

*C. myriadophylla* Peck. 84890, 12-8-51. 1 report.

*C. radicata* (Fr.) Quél. 16925, 17-9-46, JWG. 20 reports.

*C. tuberosa* (Fr.) Kummer. 16392, 10-9-45; 60218, 23-8-58, JWG. 15 reports.

*Conocybe lateritia* (Fr.) Kühner. 84891, 17-8-55. 1 report.

*C. pubescens* (Gill.) Kühner. 16544, 15-9-45. 7 reports.
*C. tenera* (Schaeff. ex Fr.) Fayod. 16913, 17-9-46. 16 reports.
*Coprinus atramentarius* Fr. 21228, 25-9-47, AHS. 8 reports.
*C. niveus* (Pers. ex Fr.) Fr. 16829, 26-9-46, JWG. 4 reports.
*C. patouillardii* Quél. 84895, 11-7-51. 2 reports.
*Cortinarius alboviolaceus* (Fr.) Kummer. 16471, 6-9-45; 16593, 21-9-46; 64131, 6-9-59, JWG; 64141, 4-9-59, JWG. 16 reports.
*C. aleuriosmus* Maire. 59967, 3-9-58, JWG. 1 report.
*C. alutaceofulvus* Britz. 65200, 9-9-59, JWG. 1 report.
*C. armillatus* (Fr.) Fr. 60208, 28-8-58, JWG. 14 reports.
*C. atkinsonianus* Kauffm. 17138, 27-9-46, AHS. 1 report.
*C. bivelus* Fr. 56556, 30-7-57, JWG. 1 report.
*C. camphoratus* Fr. 48510, 17-9-55, JWG. 1 report.
*C. castaneoides* Peck. 64732, 9-9-59, JWG. 1 report.
*C. chrysolitus* Kauffm. 16468, 8-9-45. 1 report.
*C. clintonianus* Peck. 87134, 55-10-47. 1 report.
*C. cinnamomeus* (L. ex Fr.) Fr. 16497, 15-9-45; 16872, 19-9-46, JWG; 56535, 27-7-57, JWG. 17 reports.
*C. collinitus* Fr. 16507, 2-9-45; 16792, 23-9-46, JWG; 56540, 1-8-57, JWG as f. *caeruliipes* Smith. 16 reports.
*C. collinitus* var. *trivialis* (Lange) Smith. 48522, 14-9-55, JWG; 65184, 25-9-59, JWG. 2 reports.
*C. croceofolius* Peck. 60226, 28-8-58, JWG. 2 reports.
*C. evernius* Fr. 56542, 25-7-57, JWG; 64727, 25-9-59, JWG. 5 reports.
*C. helvolus* Fr. ss. Bres. 64908, 25-9-59, JWG. 1 report.
*C. himnuleus* (Sow.) Fr. 59908, 2-9-58, JWG. 1 report.
*C. iliopodius* Fr. 59935, 4-9-58, JWG. 1 report.
*C. infractus* Fr. 59936, 4-9-58, JWG. 1 report.
*C. laniger* Fr. 60488, 28-8-58, JWG. 1 report.
*C. lilacinus* Peck. 56526, 1-8-57, JWG. 3 reports.
*C. lucorum* Fr. 60450, 28-8-58, JWG. 2 reports.
*C. malicorius* Fr. 48505, 19-9-55, JWG. 2 reports.
*C. morrisii* Peck. 16931, 17-10-47, AHS. 4 reports.
*C. mucosus* (Bull.) Ricken. 48475, 19-9-55, JWG. 1 report.
*C. ochraceus* Peck. 16797, 19-9-46, AHS. 2 reports.
*C. pholideus* Fr. 87137, 5-10-47. 1 report.
*C. raphanoides* Fr. 16906, 18-9-46; 87135, 13-9-47; 87136, 20-8-46; 88985, -45. 3 reports.
*C. renidens* Fr. 63345, 4-7-59, JWG. 1 report.
*C. sanguineus* Fr. 84547, 26-9-50. 5 reports.
*C. semisanguineus* (Fr.) Gill. 16885, 9-9-46, JWG; 60255, 28-8-58, JWG. 17 reports.
*C. sphaerosporus* Peck. 17128, 87139, 23-9-45, AHS. 5 reports.
*C. sphagnophilus* Peck. 87138, 26-7-47. 1 report.
*C. torvus* Fr. 59913, 3-9-58, JWG. 1 report.
*C. violaceus* (L.) Fr. 87027, 10-9-51, WHS. 5 reports.
*Crepidotus fulvotomentosus* Peck. 16511, 22-9-45. 13 reports.
*Crinipellis campanella* (Peck) Sing. 87144, 17-7-40; 87145, 1-8-46. 4 reports.
*C. stipitaria* (Fr.) Pat. 87147, 31-7-43. 2 reports.
*C. zonata* (Peck) Pat. 87030, 3-9-51; 87369, 16-8-55. 3 reports.
*Cystoderma amianthinum* Scop. ex Fr.) Fayod. 64214, 6-9-59, JWG; 87148, 13-9-47; 87149, 18-9-41; 87150, 3-10-46; 87381, 20-9-45, JWG. 10 reports.
*C. cinnabarinum* (Alb. & Schw. ex Secr.) Fayod. 59966, 1-9-58, JWG. 1 report.
*C. fallax* Smith & Singer. 16873, 17-9-46, AHS; 64159, 6-9-59, JWG; 87726, 26-8-51, JWG. 3 reports.
*C. granosum* (Morg.) Smith & Sing. 87151, 26-8-54. 6 reports.
*C. granulosum* (Batsch ex Fr. Fayod. 16469, 13-9-45; 16539, 17-9-45; 16790, 14-6-46; 16860, 25-9-46, JWG; 64137, 6-9-59, JWG; 87152, 2-9-54, JWG; 87153, 17-9-47, JWG; 87154, 28-8-54; 87256, 18-9-44, JWG; 87727, 7-9-51, JWG. 15 reports.

*C. granulosum* f. *robustum* Smith & Sing. 56594, 1-8-57, JWG. 1 report.

*Eccilia griseorubella* Fr. 16825, 23-9-46, AHS. 4 reports.

*E. rhodocilicioides* Atk. 60481, 24-8-58, JWG. 1 report.

*Entoloma clypeatum* Fr. 11-10-49. 2 reports.

*E. cuspidatum* Peck. 17462, 9-8-47, JWG; 87373, 27-7-45. 2 reports.

*E. grande* Peck. 61142, 3-9-58, JWG; 65187, 7-9-57, JWG. 3 reports.

*E. grayanum* (Peck) Sacc. 84450, 6-8-50. 6 reports.

*E. griseum* Peck. 16516, 15-9-45; 16838, 23-9-46, AHS; 87033, 22-9-49. 8 reports.

*E. lividum* Fr. 56546, 26-7-57, JWG; 56562, 25-7-57, JWG; 81129, 24-8-58, JWG. 6 reports.

*E. luteum* Peck. 27612, 3-9-51, SCT. 1 report.

*E. nidorosum* Fr. 16805, 23-9-46, JWG; 56529, 3-8-57, JWG. 5 reports.

*E. rhodopolium* Fr. 60495, 28-8-58, JWG; 61112, 61113, 2-9-58, JWG; 87034, 22-9-49. 9 reports.

*E. salmoneum* Peck. 60221, 24-8-58, JWG. 17 reports.

*E. scabrinellum* Peck. 84551, 7-9-50. 5 reports.

*E. sericellum* Fr. 59898, 5-9-58, JWG. 2 reports.

*E. sericeum* Fr. 56579, 30-7-57, JWG; 61130, 30-8-58, JWG; 61131, 4-9-58, JWG; 61133, 25-8-58, JWG; 61141, 2-9-58, JWG, 5 reports.

*E. strictius* (Peck) Sacc. 61138, 28-8-58, JWG; 61139, 4-9-58, JWG; 63318, 1-7-59, JWG. 17 reports.

*Flammula alnicola* (Fr.) Kummer. 16920, 21-9-46, JWG. 7 reports.

*F. lenta* (Pers. ex Fr.) Kummer. 41383, 19-9-55, JWG. 2 reports.

*F. penetrans* (Fr.) Quél. ss. Lange, 41679, 14-9-55, JWG; 61128, 28-8-58, JWG. 2 reports.

*F. sapinea* Fr. 59960, 3-9-58, JWG; 64926, 64927, 25-9-59, JWG. 6 reports.

*F. spumosa* Fr. 16952, 17-9-46, JWG; 41397, 14-9-55, JWG. 13 reports.

*Galerina hypnorum* (Schrank ex Fr.) Kühner. 16826, 23-9-46, JWG; 48504, 14-9-55, JWG. 6 reports.

*G. tibiicystis* (Atk.) Kühner 17124, 18-9-46, AHS. 2 reports.

*Hebeloma crustuliniforme* (Bull. ex Fr.) Quél. 87257, 16-10-46. 7 reports.

*Hygrophorus amoenus* (Lasch) Quél. 60002, 7-9-58, JWG. 1 report.

*H. angelesianus* Smith & Hesler. 48913, 16-8-55, JWG. 2 reports.

*H. auratocephalus* Ellis. 87159, 29-7-47. 1 report.

*H. borealis* Pk. 16834, 23-9-46, JWG; 64937, 17-9-59, JWG. 11 reports.

*H. calophyllus* Karst. 34788, 8-10-52, AHS. 1 report.

*H. cantharellus* Schw. 56931, 27-7-57, JWG. 8 reports.

*H. caprinus* (Scop. ex Fr.) Fr. 84903, 8-10-52. 2 reports.

*H. chrysodon* Fr. 87160, 7-10-47. 9 reports.

*H. colemannianus* Blox. 16929, 10-9-46, JWG; 17-1-42, 27-9-46, AHS; 84904, 24-9-48. 7 reports.

*H. conicus* Fr. 16895, 18-9-46, JWG. 18 reports.

*H. eburneus* Fr. 87162, 7-10-47. 7 reports.

*H. fusco-albus* var. *occidentalis* Kauffm. 16902, 25-9-46, JWG; 16946, 19-9-46, JWG; 84552, 16-9-50; 87163, 7-10-47, 87377, 4-10-45. 10 reports.

*H. bondurensis* Murr. 87040, 22-7-48. 1 report.

*H. immutabilis* Peck. 87041, 27-7-51; 87042, 28-6-50. 2 reports.

*H. marginatus* Peck. 60210, 28-8-58, JWG; 87164, 1-8-47. 9 reports.

*H. miniatus* Fr. 16898, 27-9-46, JWG; 60263, 28-8-58, JWG. 12 reports.

*H. nitidus* Berk. & Curt. 60258, 28-8-58, JWG. 16 reports.

*H. niveus* Fr. 16799, 19-9-46, JWG; 60253, 30-8-58, JWG. 12 reports.

*H. olivaceoalbus* Fr. 16869, 22-9-46, JWG; 60253, 30-8-58, JWG; 65199, 24-9-59, JWG. 12 reports.

*H. pallidus* Peck. 48531, 17-9-55, JWG; 60262, 2-9-58, JWG. 10 reports.

*H. peckii* Atk. 87117, 5-10-41. 8 reports.

*H. pratensis* Fr. 16868, 26-9-46, JWG; 34779, 29-9-52, SCT. 6 reports.

*H. pudorinus* Fr. 16932, 16-9-46, JWG; 64916, 24-9-59, JWG. 17 reports.

*H. puniceus* Fr. 16822, 21-9-46, JWG; 16928, 18-9-46, JWG. 15 reports.

*H. purpurascens* Schw. 16935, 18-9-46, JWG; 60030, 11-9-58, JWG. 2 reports.
*H. russula* (Fr.) Quél. 60199, 30-8-58, JWG. 14 reports.
*H. speciosus* Peck. 64902, 25-9-59, JWG; 84553, 29-9-50; 84905, 10-10-52. 5 reports.
*H. subaustralis* Smith & Hesler. 59943, 5-9-58, JWG. 1 report.
*H. subviolaceus* Peck. 87044, 26-8-51. 2 reports.
*H. tephroleucus* Fr. 16912, 25-9-46, JWG. 2 reports.
*H. virgineus* Fr. 64930, 24-9-59, JWG. 6 reports.
*Inocybe caesariata* (Fr.) Karst. 87045, 26-8-51. 1 report.
*I. calamistrata* (Fr.) Karst. 87265, 21-7-42. 5 reports.
*I. fastigiata* var. *microsperma* Bres. 56587, 31-7-57, JWG. 1 report.
*I. flocculosa* (Berk.) Sacc. 84554, 5-6-50. 3 reports.
*I. geophylla* (Fr.) Kummer. 16482, 17-9-45; 16814, 21-9-46, JWG; 56598, 27-7-57, JWG; 60270, 26-8-58, JWG. 16 reports.
*I. lacera* (Fr.) Kummer 63319, 1-9-59, JWG. 5 reports.
*I. lanuginosa* (Bull.) Sacc. 56581, 25-7-57, JWG; 87733, 1-8-46, JWG. 2 reports.
*I. leptophylla* Atk. 87166, 1-8-46. 5 reports.
*I. lilacina* (Boud.) Kauffm. 87734, 22-9-49. 7 reports.
*I. longicystis* Atk. 60256, 23-8-58, JWG. 1 report.
*I. radiata* Peck. 56563, 25-7-57; 87048, 21-7-42. 7 reports.
*I. subdestricta* Kauffm. 87165, 1-8-46. 3 reports.
*I. virgata* Atk. 60490, 26-8-58, JWG. 1 report.
*Kuehneromyces vernalis* (Peck) Sing. & Smith. 84902, 6-8-52, JWG. 1 report.
*Laccaria laccata* (Scop. ex Fr.) Berk & Br. 56567, 27-7-57, JWG. 20 reports.
*L. ochropurpurea* (Berk.) Peck. 16523, -9-45. 1 report.
*L. tetraspora* Sing. 56662, 27-7-57, JWG. 1 report.
*Lactarius affinis* Peck. 16533, 6-9-45; 16853, 18-9 46, JWG; 48515, 15-9-55. 14 reports.
*L. alpinus* Peck. 49662, 14-9-55, JWG; 49674, 14-9-55, JWG; 61132, 29-8-58, JWG. 3 reports.
*L. aspideoides* Burl. 16823, 23-9-46, JWG; 48527, 14-9-55, JWG. 2 reports.
*L. boughtonii* Peck. 48516, 19-9-55, JWG. 1 report.
*L. camphoratus* (Bull. ex Fr.) Fr. 16487, 17-9-45, JWG. 2 reports.
*L. colorascens* Peck. 49660, 17-9-55, JWG; 48700, 15-9-55, JWG; 56597, 31-7-57, JWG; 61120, 3-9-58, JWG. 3 reports.
*L. deceptivus* Peck. 48519, 15-9-55, JWG; 60245, 23-8-58, JWG. 8 reports.
*L. deliciosus* (L. ex Fr.) Gray. 16459, 10-9-45; 16756, 8-9-45, JWG; 16883, 18-9-46, JWG. 19-reports.
*L. glyciosmus* Fr. 16865, 26-9-55, JWG. 1 report.
*L. griseus* Peck. 59937, 2-9-58, JWG. 2 reports.
*L. helvus* Fr. 49659, 15-9-55, JWG; 49667, 17-9-55, JWG; 49682, 14-9-55, JWG. 7 reports.
*L. hibbardae* Peck. 61126, 6-9-58, JWG; 64931, 16-9-59, JWG. 2 reports.
*L. hysginus* Fr. 16460, 15-9-45, JWG; 16813, 21-9-46, JWG. 8 reports.
*L. lignyotus* Fr. 49684, 17-9-55, JWG; 56564, 30-7-57, JWG; 60200, 28-8-58, JWG. 9 reports.
*L. maculatus* Peck. 87049, 17-8 48. 3 reports.
*L. minusculus* Burl. 61125, 30-8-58, JWG. 1 report.
*L. mucidus* Burl. 49681, 14-9-55, JWG; 49686, 16-9-55, JWG; 64091, 8-9-59, JWG; 64129, 7-9-59, JWG. 2 reports.
*L. necator* (Pers. ex Fr.) Karst. 59440, 1-9-58, JWG. 4 reports.
*L. oculatus* (Peck) Burl. 59905, 1-9-58, JWG. 5 reports.
*L. paludinellus* Peck. 16875, 23-9-46, JWG. 1 report.
*L. parvus* Peck. 16841, 23-9-46, AHS; 64738, 7-9-59, JWG. 6 reports.
*L. pyrogalus* (Bull. ex Secr.) Fr. 56628, 3-8-57, JWG; 61143, 25-8-58, JWG. 3 reports.
*L. representaneus* Britz. 16855, 23-9-46, AHS; 48525, 14-9-55; 48529, 15-9-55; 56530, 25-7-57, JWG; 84907, 16-8-54. 10 reports.
*L. rimosellus* Peck. 60272, 28 8-58, JWG. 1 report.
*L. rufus* (Scop. ex Fr.) Fr. 16894, 19-9-46, JWG; 16930, 18-9-46, JWG; 49687, 16-9-55, JWG; 60257, 23-8-58, JWG. 4 reports.
*L. scrobiculatus* (Scop. ex Fr.) Fr. 16936, 27-9-46, JWG; 49701, 16-9-55, JWG; 60244, 2-9-58, JWG; 87741, 20-7-41. 17 reports.

*L. subdulcis* (Bull. ex Fr.) Gray. 16457, 15-9-45, ILC. 18 reports.

*L. theiogalus* (Bull.) Fr. 16808, 23-8-46, JWG; 16886, 26-9-46, PWG. 6 reports. These may be *L. chrysorrheus.*

*L. torminosus* (Schaeff. ex Fr.) Gray. 16379, 15-9-45. 16 reports.

*L. trivialis* Fr. 56577, 25-7-57, JWG. 14 reports.

*L. uvidus* Fr. 16796, 23-9-46, JWG; 16922, 17135, 23-9-46, AHS; 48503, 14-9-55, JWG; 60214, 3-9-58, JWG. 11 reports.

*L. zonarius* (Bull.) Fr. 61144, 6-9-58, JWG. 1 report.

*Lentinus cochleatus* Pers. ex Fr. 87271, 9-8-47; 87272, 3-8-40. 9 reports.

*L. omphalodes* Fr. 60274, 2-9-58, JWG. 1 report.

*L. spretus* Peck. 87276, 2-7-41, WHS. 2 reports.

*Lepiota americana* Peck. 84556, 6-8-50. 2 reports.

*L. clypeolaria* (Bull. ex Fr.) Kummer. 16809, 17-9-46, JWG; 60264, 30-8-58, JWG; 64921, 6-9-59, JWG; 87174, 18-9-41. 14 reports.

*L. felina* Fr. 87175, 14-9-41; 87176, 20-9-47, 87384, 11-10-45. 5 reports.

*L. fuscosquamea* Peck. 16449, 15-9-45, SCT; 56532, 18-8-57, JWG; 59910, 2-9-58, JWG; 60265, 30-8-58, JWG; 64954, 6-9-59, JWG. 4 reports.

*L. naucina* Fr. 16405, 10-9-45, ILC; 16889, 23-9-46, JWG; 87177, -9-41. 14 reports.

*Lepista nuda* (Bull. ex Fr.) W. G. Sm. 87508, 10-10-45. 2 reports.

*L. personata* (Fr.) W. G. Smith. 16501, 8-9-45; 16891, 17-9-46. 16 reports.

*Leptonia asprella* Fr. 59928, 3-9-58, JWG; 87178, 18-8-46, JWG; 87380, 17-7-45. 11 reports.

*L. formosa* (Fr.) Gill. 56655, 31-7-57, JWG; 60484, 20-8-58, JWG; 87179, 9-8-47; 87180, 17-8-46. 14 reports.

*L. lampropoda* Fr. 87181, 17-8-46. 6 reports.

*L. serrulata* Fr. 87052, 11-7-41; 87183, 17-8-46. 9 reports.

*L. subserrulata* Peck. 59927, 3-9-58, JWG. 1 report.

*Leucopaxillus albissimus* var. *piceinus* (Peck) Sing. & Sm., 16458, 17-9-45, HEB; 16945, 27-9-46, JWG; 84926, 11-9-50, JWG; 87278, 4-9-44; 87385, 20-9-45. 12 reports.

*L. laterarius* (Peck) Sing. & Sm., 87055, 15-9-49. 1 report.

*Limacella glischra* (Morg.) Earle, 56642, 1-8-57, JWG. 1 report.

*L. illinita* (Fr.) Earle, 16871, 25-9-46, JWG; 56534, 1-8-57, JWG; 84999, 9-8-48. 10 reports.

*L. illinita* var. *argillacea* (Fr.) H. V. Smith, 56592, 1-8-57, JWG. 1 report.

*L. illinita* var. *rubescens* H. V. Smith, 56630, 1-8-57, JWG; 87381, 22-9-45. 2 reports.

*Marasmius androsaceus* (L. ex Fr.) Fr., 87057, 4-8-39; 87187, 20-9-42. 7 reports.

*M. cohaerens* Fr., 21332, 17-8-48, JWG. 2 reports.

*M. epiphyllus* Fr., 16768, 9-11-45, JWG; 16830, 25-9-46, JWG. 9 reports.

*M. rotula* Fr., 60267, 26-8-58, JWG. 18 reports.

*M. scorodonius* Fr. 16824, 15-9-46, JWG; 60215, 26-8-58, JWG; 64182, 24-9-59, JWG. 19 reports.

*M. siccus* Schw. 64209, 24-9-59, JWG. 8 reports.

*M. subpilosus* Peck. 87896, 19-9-46, JWG. 1 report.

*Melanoleuca alboflavida* (Peck) Murr. 16837, 19-9-46, JWG; 16934, 27-9-46, JWG. 11 reports.

*M. melaleucum* (Pers. ex Fr.) Murr. 87284, 3-9-46. 1 report.

*Mycena amabilissima* (Peck) Sacc. 56533, 26-7-57, JWG. 2 reports.

*M. citrinomarginata* Gill. 84910, 1-8-48. 1 report.

*M. delicatella* (Peck) Smith. 17133, 18-9-46, AHS. 11 reports.

*M. elegantula* Peck. 84914, 13-9-51. 2 reports.

*M. filiformis* Smith, 63320, 4-7-59, JWG. 1 report.

*M. galericulata* (Fr.) Gray. 16450, 12-9-45. 9 reports.

*M. haematopa* var. *marginata* Lange. 56668, 3-8-57, JWG. 1 report.

*M. pelianthina* (Fr.) Quél. 84915, 8-9-39. 1 report.

*M. pura* (Fr) Kummer, 64918, 6-9-59, JWG. 18 reports.

*M. purpureofusca* (Peck) Sacc. 84911, 25-9-49. 1 report.

*M. strobilinoides* Peck. 21699, 1-10-49; 84912, 3-10-49, AHS; 84913, 10-10-51. 4 reports.

*M. tenuiceps* Smith, 84128, 6-9-59, JWG. 1 report.
*Naematoloma capnoides* (Fr.) Karst. 64203, 24-9-59, JWG; 89025, 20-9-45, JWG. 7 reports.
*N. elongatum* (Pers. ex Fr. Konr. 16820, 23-9-46, JWG; 41391, 19-9-55, JWG. 4 reports.
*N. fasciculare* (Huds. ex Fr.) Karst. 87056, 5-10-52; 89026, 23-9-47, JWG. 4 reports.
*N. olivaceotinctum* (Kauffm.) Smith. 48526, 15-9-55, JWG. 1 report.
*N. sublateritium* (Fr.) Karst. 16941, 17-9-46, JWG. 17 reports.
*N. udum* (Pers. ex Fr.) Karst. 41675, 19-9-55, JWG. 1 report.
*Naucoria bellula* Peck, 87190, 18-8-46. 1 report.
*Nolanea coelestina* var. *violacea* Kauffm. 84558, 7-9-50. 1 report.
*N. conica* Peck. 87191, 29-7-46; 87389, 29-8-45. 8 reports.
*N. mammosa* Fr. 87192, 3-10-46. 3 reports.
*Omphalia chrysophylla* (Fr.) Kummer. 21952, 20-10-49, JWG; 64920, 7-9-59, JWG. 64920, 7-9-59, JWG. 2 reports.
*Panaeolus retirugis* (Fr.) Quél. 16842, 21-9-46, JWG. 8 reports.
*P. solidipes* (Peck) Sacc., 87193, 4-7-47; 87283, 13-7-46. 8 reports.
*Panus rudis* Fr. 87059, 26-7-48, JWG. 3 reports.
*P. stipticus* Fr. 16383, 12-9-45. 19 reports.
*P. torulosus* Fr. 87268, 20-8-55. 2 reports.
*Paxillus atrotomentosus* Fr. 87060, 12-8-51. 3 reports.
*P. involutus* Fr. 16506, 10-9-45; 16918, 17-9-46, JWG; 48524, 17-9-55, JWG. 20 reports.
*P. panuoides* Fr. 87194, 24-8-54. 1 report.
*Pholiota aeruginea* Peck, 24687, 28-9-50, JWG. 1 report.
*P. confragosa* Fr. 84918, 30-8-52. 1 report.
*P. discolor* Peck. 48535, 16-9-55, JWG. 1 report.
*P. erinaceella* Peck. 56571, 27-7-57, JWG. 1 report.
*P. marginata* (Batsch) Fr. 16812, 17-9-46, JWG; 17125, 18-9-46, AHS. 6 reports.
*P. minima* Peck. 84560, 20-9-50. 5 reports.
*P. ombrophila* Fr. 48500, 16-9-55, JWG. 1 report.
*P. platyphylla* Kauffm. 87393, 20-9-45, JWG. 1 report.
*P. praecox* (Pers. ex Fr.) Kummer. 87061, 11-7-50. 2 reports.
*P. rugosa* Peck. 84561, 7-9-50; 84919, 15-9-49. 2 reports.
*P. squarrosoides* Peck. 87750, 6-9-45. 7 reports.
*P. togularis* (Bull.) Kummer. 59944, 2-9-58, JWG; 84920, 22-9-52. 6 reports.
*Phyllotopsis nidulans* (Pers. ex Fr.) Sing. 84921, 18-9-44; 87196, 26-8-54. 3 reports.
*Pleurotus albolanatus* Peck. 87280, 27-9-46, JWG. 3 reports.
*P. elongatipes* Peck. 59969, 5-9-58, JWG. 1 report.
*P. porrigens* (Pers. ex Fr.) Kummer. 16810, 11-9-46, AHS; 16933, 26-9-46, JWG; 48478, 16-9-55, JWG. 10 reports.
*P. serotinus* Fr. 16844, 22-9-46, JWG; 35288, 19-10-52; 35299, 14-10-52. 15 reports.
*P. ulmarius* Fr. 16958, 17-9-46, JWG; 16960, 27-9-46, JWG. 5 reports.
*Pluteus atromarginatus* (Sing.) Kühner. 61115, 26-8-58, JWG. 1 report.
*P. cervinus* (Schaeff. ex Secr.) Fr. 16522, 15-9-45; 16903, 17-9-46, JWG. 17 reports.
*P. chrysophlebius* (Berk. & Rav.) Sacc. 16456, 12-9-45. 9 reports.
*P. fuliginosus* Murr. 61147, 26-8-58, JWG. 1 report.
*P. leoninus* (Schaeff. ex Fr.) Kummer. 60212, 3-9-58, JWG; 84422, 13-7-51. 3 reports.
*P. salicinus* (Pers. ex Fr.) Kummer. 64925, 24-9-59, JWG. 2 reports.
*P. umbrosus* (Pers. ex Fr.) Kummer. 84923, 9-8-48. 4 reports. This is probably *P. atromarginatus*.
*P. washingtoniensis* Murr. 61117, 23-8-58, JWG. 1 report.
*Psathyrella hydrophila* (Fr.) Smith, 16874, 17-9-46, AHS; 17131, 21-9-46, AHS. 3 reports.
*Psilocybe agrariella* Atk. 84924, 13-9-49. 1 report.
*Rozites caperata* (Pers. ex Fr.) Karst. 16893, 21-9-46, JWG; 48501, 19-9-55, JWG. 16 reports.
*Ripartites tricholoma* (Alb. & Schw. ex Fr.) Karst. 64217, 24-9-59, JWG. 1 report.
*Russula adusta* Fr. 60261, 31-8-58, JWG. 1 report.
*R. aeruginea* Lindbl. 16854, 17-9-46, JWG; 16884, 11-9-46, JWG; 56554, 3-8-58, JWG. 13 reports.

*R. albidula* Peck. 60456, 25-8-58, JWG. 2 reports.

*R. alutacea* Fr. 56558, 26-7-57, JWG; 56574, 56585, 1-8-57, JWG; 56591, 31-7-57, JWG; 60448, 26-8-58, JWG. 9 reports.

*R. atrorubens* Quél. 49685, 14-9-55, JWG; 64148, 8-9-59, JWG. 2 reports.

*R. aurantiolutea* Kauff. 16892, 26-9-46, JWG; 56640, 30-7-57, JWG. 7 reports.

*R. ballouii* Peck. 60460, 28-8-58, JWG. 1 report.

*R. basifurcata* Peck. 16858, 25-9-46, JWG; 49656, 14-9-55, JWG; 49661, 16-9-55, JWG. 2 reports.

*R. chamaeleontina* Fr. 61080, 29-8-58, JWG. 1 report.

*R. claroflava* Grove. 56568, 1-8-57, JWG; 60211, 23-8-58, JWG; 64180, 25-9-59, JWG. 13 reports.

*R. compacta* Frost & Peck. 49671, 15-9-55, JWG. 1 report.

*R. crustosa* Peck, 64132, 16-9-59, JWG. 1 report.

*R. decolorans* Fr. 56553, 3-8-57, JWG; 64196, 9-9-59, JWG. 2 reports.

*R. delica* Fr. 16908, 23-9-46, JWG. 2 reports.

*R. emetica* (Pers. ex Fr.) Fr., 49655, 49658, 19-9-55, JWG. 18 reports.

*R. fallax* Fr. ss. Kauff. 16470, 15-9-45, JWG; 16900, 23-9-46, JWG; 49665, 49696, 15-9-55, JWG; 60233, 26-8-58, JWG. 14 reports.

*R. flocculosa* Burl. 64702, 24-9-59, JWG. 1 report.

*R. foetentula* Peck. 56639, 25-7-57, JWG; 59906, 4-9-58, JWG; 60459, 25-8-58, JWG; 61024, 14-9-55, JWG; 61025, 17-9-55, JWG. 3 reports.

*R. fragilis* (Pers. ex Fr.) Fr., 16887, 16957, 26-9-46, JWG; 49668, 15-9-55, JWG; 49669, 49678, 49695, 14-9-55, JWG; 56548, 27-7-57, JWG; 60463, 26-8-58, JWG. 14 reports.

*R. fucosa* Burl. 49673, 16-9-55, JWG. 1 report.

*R. gracilis* Burl. 49694, 15-9-55, JWG; 49702, 16-9-55, JWG; 56550, 26-7-57, JWG; 61074, 25-8-58, JWG; 64197, 6-9-59, JWG. 5 reports.

*R. grisea* (Pers. ex Secr.) Gill. 56547, 56654, 26-7-57, JWG; 2 reports.

*R. heterophylla* Fr. 61114, 3-9-58, JWG. 1 report.

*R. integra* Fr. 64213, 6-9-59, JWG. 5 reports.

*R. kauffmaniana* (Sing.) Sing. 56584, 26-7-57, JWG. 1 report.

*R. macropoda* Sing. 64186, 6-9-59, JWG. 1 report.

*R. magnifica* Peck. 16881, 18-9-46, JWG. 1 report.

*R. nigricans* (Bull.) Fr. 49697, 16-9-55, JWG. 10 reports.

*R. olivascens* Fr. 61086, 4-9-58, JWG. 1 report.

*R. paludosa* Britz. 16794, 20-9-46, JWG; 60455, 60466, 28-8-58, JWG; 60473, 23-8-58, JWG. 2 reports.

*R. pseudolepida* Sing. 64185, 7-9-59, JWG. 1 report.

*R. puellaris* Fr. 16863, 25-9-46, JWG; 16899, 23-9-46, JWG; 16951, 27-9-46, JWG; 49677, 16-9-55, JWG. 3 reports.

*R. rubrotincta* (Peck) Burl. 16857, 23-9-46, JWG; 49654, 15-9-55, JWG; 61100, 61123, 4-9-58, JWG. 5 reports.

*R. serissima* Peck. 60452, 31-8-58, JWG; 61095, 30-8-58, JWG. 1 report.

*R. sordida* Peck. 27542, 27-7-51, JWG. 12 reports.

*R. squalida* Pk. 60451, 26-8-58, JWG; 64202, 7-9-59, JWG. 11 reports.

*R. temuiceps* Kauff. 56638, 1-8-57, JWG; 61093, 4-9-58, JWG. 2 reports.

*R. turci* Bres. 61124, 30-8-58, JWG. 2 reports.

*R. variata* Banning, 16447, 15-9-45, ILC. 11 reports.

*R. vesca* Fr. 49693, 17-9-55, JWG; 61094, 29-8-58, JWG; 61119, 2-9-58, JWG; 64168, 24-9-59, JWG; 64190, 64201 8-9-59, JWG. 4 reports.

*R. veternosa* Fr. 56593, 25-7-57, JWG. 1 report.

*R. xerampelina* (Schaeff.) Fr. 16861, 16896, 27-9-46, JWG; 16949, 17-9-46, JWG; 49670, 15-9-55, JWG; 56543, 1-8-57, JWG; 60471, 25-8-58, JWG; 64149, 7-9-59, JWG. 8 reports.

*Schizophyllum commune* Fr. 84927, 11-9-49. 16 reports.

*Stropharia aeruginosa* (Curt. ex Fr.) Quél. 16926, 87289, 27-9-46, JWG; 84929, 8-10-52; 84930, 13-10-53. 3 reports.

*S. hornemannii* (Fr.) Lund. & Nannf. 16880, 17-9-46, JWG; 87065, 20-9-49; 87290, 14-9-41. 12 reports.

*S. semiglobata* (Batsch ex Fr.) Quél. 16543, 15-9-45, ILC; 16802, 21-9-46, JWG; 48530, 20-9-55, JWG. 18 reports.
*S. squamosa* var. *thrausta* Kalchbr. 34781, 12-10-52, SCT; 84928, 26-9-53. 2 reports.
*S. ventricosa* Mass. 84931, 30-9-49. 2 reports.
*Tricholoma aurantium* (Schaeff. ex Fr.) Ricken. 74524, 24-9-59, JWG; 87013, 16-9-50. 3 reports.
*T. fallax* Peck. 56578, 31-7-57, JWG; 64134, 6-9-59, JWG. 2 reports.
*T. flavobrunneum* (Fr.) Kummer. 64936, 25-9-59, JWG. 1 report.
*T. flavovirens* (Pers. ex Fr.) Lundell. 16455, 12-9-45, ILC; 16843, 21-9-46, JWG; 50243, 15-9-55, JWG. 15 reports.
*T. imbricatum* Fr. 48513, 14-9-55, JWG; 87197, 30-9-47. 6 reports.
*T. intermedium* Peck. 50240, 15-9-55, JWG. 1 report.
*T. pessundatum* (Fr.) Quél. 17132, 23-9-46, AHS; 64166, 24-9-59, JWG; 84935, 2-9-48. 3 reports.
*T. resplendens* Fr. 64144, 7-9-59, JWG. 1 report.
*T. saponaceum* (Fr.) Kummer. 16940, 27-9-46, JWG; 48067, 15-9-45, JWG; 56575, 1-8-57, JWG; 61118, 6-9-58, JWG; 64093, 6-9-59, JWG. 13 reports.
*T. sejunctum* (Sow. ex Fr.) Quél. 16526, 6-9-45; 50232, 15-9-55, JWG. 12 reports.
*T. subacutum* Peck. 16464, 6-9-45; 16927, 18-9-46, JWG; 48507, 15-9-55, JWG; 64109, 8-9-59, JWG. 14 reports.
*T. terreum* Fr. 21945, 10-10-49, JWG; 64162, 6-9-59, JWG. 6 reports.
*T. transmutans* Peck. 87066, 23-9-50. 6 reports.
*T. ustale* Fr. 16803, 23-9-46, AHS; 59957, 30-8-58, JWG; 6 reports.
*T. vaccinum* (Fr.) Kummer. 16890, 18-9-46, JWG. 9 reports.
*Tricholomopsis decora* (Fr.) Sing. 16923, 18-9-46, JWG. 9 reports.
*T. rutilans* (Schaeff. ex Fr.) Sing. 16876, 26-9-46, JWG. 16 reports.
*Trogia crispa* Fr. 16385, 10-9-45, ILC; 16831, 19-9-46, JWG. 14 reports.
*Volvariella bombycina* (Schaeff. ex Fr.) Sing. 84563, 28-7-50, RP. 1 report.
*Xeromphalina cauticinalis* (Fr.) Kühner & Maire. 17129, 25-9-46, AHS. 1 report.
*X. kauffmanii* Smith. 16914, 19-9-46, HEB. 1 report.

The following species were reported but no specimens preserved: *Agaricus comptulus* Fr. (1); *A. edulis* (Vitt.) Moell. & Schaeff. (5); *A. placomyces* Peck (1); *A. subrufescens* Peck (2); *Amanita citrina* (Schaeff.) ex S. F. Gray, reports of this species and *A. brunnescens* were confused under the name *A. mappa; A. frostiana* Peck (13); *A. velatipes* Atk. (1); *Amanitopsis inaurata* (Secr.) Fayod (10); *A. vaginata* Fr. (20), all three color forms were included under this name; *Asterophora lycoperdoides* (Bull.) Ditm. ex Gray (1).

*Bolbitius vitellinus* (Pers. ex Fr.) Fr. (6).

*Claudopus variabilis* (Pers. ex Fr.) Gill. (3); *Clitocybe albidula* Peck (1); *C. caespitosa* Peck (1); *C. cartilaginea* Bres. (2); *C. ditopoda* Fr. (2); *C. fragrans* (Sow. ex Fr.) Kummer (2); *C. geotropa* Fr. (1); *C. gibba* (Fr.) Kummer (19); *C. leptoloma* (Peck) Peck (1); *C. nebularis* (Fr.) Kummer (1); *C. robusta* Peck (1); *C. sinopica* (Fr.) Kummer (2); *C. squamulosa* (Fr.) Kummer (1); *C. vernicosa* Fr. (8); *Clitopilus abortivus* Berk. & Curt. (4); *C. micropus* Peck (1); *C. noveboracensis* Peck (1); *C. subvilis* Peck (1); *Collybia abundans* (Peck) Sacc. (5); *C. alcalinolens* Peck (1); *C. colorea* Peck (3); *C. conigenoides* (Ell.) Sacc. (4); *C. dryophila* (Bull. ex Fr.) Kummer (20); *C. lacunosa* Peck (1); *C. longipes* (Fr.) Kummer (5); *C. maculata* (Alb. & Schw. ex Fr.) Kummer (8); *C. velutipes* (Curt. ex Fr.) Kummer (5); *Conocybe antipoda* (Lasch) Kühner (1); *C. bulbifera* (Kauffm.) Romagn. (7); *Coprinus ephemerus* Fr. (4); *C. fimetarius* Fr. (1); *C. insignis* (Müll. ex Fr.) Gray (2); *C. micaceus* (Bull. ex Fr.) Fr. (10); *C. plicatilis* (W. Curt. ex Fr.) Fr. (5); *C. quadrifidus* Peck (2); *C. radiatus* Fr. (5); *C. sclerotigenus* Ell. & Ev. (1); *C. semilanatus* Peck (2); *C. stercorarius* Fr. (1); *C. sterquilinus* Fr. (3); *C. tomentosus* Fr. (6); *Cortinarius albidifolius* Peck (1); *C. coloratus* Peck (3); *C. corrugatus* Peck (1); *C. croceoconus* Fr. (1); *C. cylindripes* Kauffm. (3); *C. distans* Peck (1); *C. elegantior* Fr. (2); *C. fulgens* Fr. (4); *C. gracilis* (Peck) Sacc. (3); *C. heliotropicus* Peck (1); *C. iodes* Berk. & Curt. (1); *C. luteolus* (1); *C. multiformis* Fr. (1); *C. ophiopus Peck* (1); *C. purpurascens* Fr. (4); *C. squarrosus* Clements (2); *C. squamulosus* Peck (2); *C. subpulchrifolius* Kauffm. (2); *C. subpurpurascens* Fr. (1); *Crepidotus croco-*

*phyllus* (Berk.) Sacc. (1); *C. dorsalis* Peck (1); *C. herbarum* (Peck) Sacc. (2); *C. malachius* (Berk. & Curt.) Sacc. (4); *C. mollis* (Bull. ex Fr) Kummer (1); *C. stipitatus Kauffm.* (1); *C. versutus* (Peck) Sacc. (7); *Crinipellis setipes* (Peck) Sing. (3); *Cystoderma amianthinum* var. *amianthinum* f. *rugosoreticulatum* (Lorinser) Smith & Sing. (4); *C. granulosum* var. *adnatifolium* (Peck) Smith & Sing. (3); *C. pulveraceum* (Peck) Smith & Sing. (9).

*Eccilia atrides* Fr. (10); *E. pentagonospora* Atk. (7); *E. pirinoides* Kauffm. (9); *Entoloma cyaneum* (Peck) Sacc. (1); *E. peckianum* Burt (1); *E. sericatum* Britz. (4); *E. sinuatum* Fr. (1).

*Flammula gummosa* (Lasch) Kummer (1); *F. lubrica* (Pers. ex Fr.) Kummer (2).

*Galerina sphagnorum* (Pers. ex Fr.) Kühner (8).

*Hebeloma gregarium* Peck (1); *H. sarcophyllum* (Peck) Sacc. (1); *H. sinapizans* Fr. (1); *Hygrophorus amygdalinus* Peck (2); *H. capreolarius* Kalchbr. (8); *H. ceraceus* Fr. (5); *H. chlorophanus* Fr. (18), *probably* this is *H. flavescens; H. coccineus* Fr. (13), probably this is *H. puniceus; H. discoideus* Fr. (5); *H. eburneus* var. *decipiens* Peck (1); *H. fimbriatophyllus* Kauffm. (1); *H. flavescens* (Kauffm.) Smith & Hesl. (1); *H. flavodiscus* Frost in Peck (3); *H. fuligineus* Frost in Peck (12); *H. laetus* Fr. (1); *H. laurae* Morg. (1); *H. miniatus* var. *sphagnophilus* Peck (1); *H. olivaceoalbus* var. *gracilis* Maire (1); *H. peckianus* Howe (1); *H. psitticinus* Fr. (15); *H. tephroleucus* var. *aureofloccosus* Smith & Hesl. (1), RP; *H. unguinosus* Fr. (1).

*Inocybe asterospora* Quél. (2); *I. fastigiata* (Schaeff.) Karst. (8); *I. lanatodisca* Kauffm. (3); *I. pyriodora* (Pers.) Bres. (1); *I. rimosa* (Bull.) Kummer (3); *I. scaber* Fr. (1).

*Laccaria amethystina* (Bolt. ex Fr.) Berk. & Br. (1); *L. chrysorheus* Fr. (1), probably reports of *L. theiogalus* belong here; *L. cilicioides* Fr. (1); *L. cinereus* Peck (1); *L. circellatus* Fr. (1); *L. controversus* (Pers. ex Fr.) Fr. (6); *L. croceus* Burl. (1); *L. fuliginosus* Fr. (1); *L. insulsus* Fr. (8); *L. isabellinus* Burl. (1); *L. piperatus* (L. ex Fr.) Gray (17); *L. thyinos* Smith (1); *L. varius* Peck (4); *L. vellereus* Fr. (3); *L. volemus* Fr. (5); *Lentinus lepideus* Fr. (2); *L. umbilicatus* Peck, (1); *Lepiota acerina* Peck (1;) *L. acutaesquamosa* Fr. (12); *L. brunnea* Farl. & Burt (1); *L. clypeolarioides* Rea (1); *L. cristata* Fr. (3); *Leptonia aeruginosa* Peck (1, and sketch); *L. incana* Fr. (3): *L. rosea* Longyear (1); *L. seticeps* Atk. (1); *Leucopaxillus albissimus* (Peck) Sing. (3); *L. candidus* (Bres.) Sing. (2); *L. pulcherrimus* (Peck) Sing. & Smith (2); *Limacella glioderma* (Fr.) Earle (1).

*Marasmius capillaris* Morg. (2); *M. oreades* Fr. (20); *M. semihirtipes* Peck (1); *M. subnudus* Ell. (1); *Mycena acicula* (Fr.) Kummer, (4); *M. clavicularis* (Fr.) Gill. (2); *M. epipterygia* (Fr.) Gray (5); *M. fibula* (Fr.) Kühner (12); *M. gracilis* (Quél.) Kühner (1); *M. haematopoda* (Fr.) Kummer (10); *M. kuehneriana* Smith (1); *M. leajana* (Berk.) Sacc. (7); *M. lilacifolia* (Peck) Smith (1); *M. parabolica* (Fr.) Quél (1); *M. praelonga* (Peck) Sacc. (1); *M. rosella* (Fr.) Kummer (1); *M. sanguinolenta* (Fr.) Kummer (2); *M. vulgaris* (Fr.) Quél. (1).

*Naematoloma ericaea* (Pers. ex Fr.) Sing. (1); *Naucoria lignicola* Peck (1); *N. tabacina* Fr. (1); *N. fuscogrisella* Peck (1); *N. papillata* Bres. (1); *N. versatilis* Fr. (3).

*Omphalia fibuloides* Peck (3); *O. gracillima* Fr. (4); *O. onisca* Fr. (1); *O. scyphoides* Fr. (2).

*Panaeolus papilionaceus* (Bull. ex Fr.) Quél. (15); *P. semiovatus* (Sow. ex Fr.) Lund. & Nannf. (1); *P. sphinctrinus* (Fr.) Quél. (15); *Panus angustatus* Berk. (1); *P. strigosus* Berk. & Curt. (5); *Pholiota adiposa* Fr. (17) this is probably *P. aurivella* (Batsch) Fr.; *P. albocremulata* Peck (1); *P. erebia* Fr. (1); *P. praecox* var. *minor* Fr. (1); *P. unicolor* (Vahl) Fr. (4); *P. vermiflua* Peck (1); *Pleurotus candidissimus* Berk. & Curt. (10); *P. fimbriatus* var. *regularis* Kauffm. (1); *P. sapidus* Kalchbr. (14); *P. septicus* Fr. (2); *Pluteus ephebius* Fr. (1); *P. granularis* Peck (2); *P. granularis* var. *umbrosellus* Atk. (1); *P. longistriatus* (Peck) Sacc. (1); *P. nanus* (Pers. ex Fr.) Kummer (2); *P. tomentosulus* (Peck) Peck (1); *Psathyra semivestita* Berk. & Br. (3); *P. vestita* Peck (2); *Psathyrella candolleana* (Fr.) Smith (12); *Psilocybe cernua* Fr. (3).

*Rhodotus palmatus* (Bull. ex Fr.) Maire (1); *Russula abietina* Peck (3); *R. albida* Peck (1); *R. amygdaloides* Kauffm (1); *R. aurata* (With.) Fr. (1); *R. bicolor* Burl. (1); *R. densifolia* (Secr. ex Fr.) Gill. (11); *R. earlei* Peck (1); *R. foetens* (Pers. ex Fr.)

Fr. (20); *R. fulvescens* Burl. (3); *R. lepida* Fr. (2); *R. lutea* (Huds.) Fr. (1); *R. mariae* Peck (18); *R. ochrophylla* Peck (1); *R. palustris* Peck (3); *R. pectinata* Fr. (4); *R. pectinatoides* Peck (2); *R. purpurina* Peck (2); *R. roseipes* (Secr.) Bres. (1); *R. rugulosa* Peck (2); *R. sanguinea* Bull. ex Fr. (2); *R. sericeonitens* Kauffm. (1); *R. subdepallens* Peck (3); *R. viridella* Peck (2).

*Tricholoma acerbum* Fr. (4); *T. acre* Peck (1); *T. album* Fr. (1); *T. columbetta* Fr. (3); *T. laticeps* Kauffm. (1); *T. panaeolum* var. *caespitosum* Bres. (3); *T. subluteum* Peck (1); *Tricholomopsis platyphylla* (Fr.) Sing. (18); *Tubaria pellucida* (Bull.) Fr. (1).

*Xeromphalina campanella* (Batsch ex Fr.) Kühner & Maire (20).

### BOLETACEAE

*Boletinus cavipes* (Opat.) Kalchbr. 16517, 8-9-45; 16866, 18-9-46, JWG; 48467, 16-9-55, JWG; 87299, 19-9-55; 87398, 20-9-45. 14 reports.

*B. paluster* (Peck) Peck 48473, 19-9-55. 1 report.

*B. pictus* Peck 16532, 15-9-45. 15 reports.

*Boletus edulis* Bull. ex Fr. 16531, 12-9-45, ILC; 16535, 14-9-45; 56583, 31-7-57, JWG; 64906, 6-9-59, JWG. 18 reports.

*B. miniato-olivaceus* Frost 87755, 10-8-55, JWG. 1 report.

*B. subvelutipes* Peck 65174, 9-6-59, JWG; 87756, 22-8-55, JWG. 16 reports.

*B. vermiculosus* Peck 87757, 22-8-55. 1 report.

*Fuscoboletinus aeruginascens* (Secr.) Pomerl. & Smith 16536, 8-9-45; 16879, 18-9-46, JWG; 16962, 22-9-46, JWG; 48521, 16-9-55; 60231, 30-8-58, JWG. 15 reports.

*F. sinuspaulianus* Pomerl. & Smith 16525, 17-9-45, RP. 1 report.

*F. spectabilis* (Peck) Pomerl. & Smith 16777, 8-9-45, JWG; 16864, 18-9-46, JWG; 48517, 19-9-55; 87202, 13-9-47; 87399, 20-9-45. 8 reports.

*Gomphidius glutinosus* Fr. 16518, 6-9-45, RS; 16882, 25-9-46, JWG; 16919, 27-9-46, JWG; 21275, 87158, 13-9-47; 48534, 15-9-55, JWG; 59953, 30-8-58, JWG; 84897, 24-9-48. 11 reports.

*G. rutilus* (Schaeff. ex Fr.) Lund. & Nannf. 87530, 29-7-55, JWG. 1 report.

*Gyrodon merulioides* (Schw.) Sing. 87533, 29-7-55. 1 report.

*Gyroporus castaneus* (Bull. ex Fr.) Quél. 60271, 30-8-58, JWG. 6 reports.

*G. cyanescens* (Bull. ex Fr.) Quél. 16530, 13-9-45. 9 reports.

*Leccinum aurantiacum* (Bull.) S. F. Gray 16477, 15-9-45; 16847, 21-9-46, JWG; 39364, 10-9-45, JWG; 60494, 26-8-58, JWG; 64941, 25-9-59, JWG. 20 reports.

*L. holopus* (Rostk.) Watling 16534, 10-9-45, JWG; 56541, 4-8-57, JWG; 59907, 2-9-58, JWG; 60220, 28-8-58, JWG; 60260, 23-8-58, JWG; 63288, 1-7-59, JWG; 64178, 7-9-59, JWG; 74109, 21-9-46, JWG. 11 reports.

*L. oxydabile* (Sing.) Sing. 16959, 21-9-46, JWG. 1 report.

*L. scabrum* (Bull. ex Fr.) Gray 16878, 26-9-46, JWG; 56582, 26-7-57, JWG. 20 reports.

*L subglabripes* (Peck) Sing 59934, 3-9-58, JWG; 64736, 7-9-59, JWG. 11 reports.

*Porphyrellus gracilis* (Peck) Sing. 16877, 10-9-46, JWG. 13 reports.

*P. pseudoscaber* (Secr.) Sing. 87071, 14-8-48; 87281, 8-8-55. 4 reports.

*Pulveroboletus retipes* (Berk. & Curt.) Sing. 87203, 1-8-47. 14 reports.

*Suillus americanus* (Peck) Snell 16513, 17-9-45. 18 reports.

*S. granulatus* (L. ex Fr.) Kuntze 16446, 15-9-45, JWG; 16537, 17-9-45; 16848, 1946, JWG. 19 reports.

*S. grevillei* (Fr.) Snell 16500, 87506, 8-9-45; 16956, 18-9-46, JWG; 16921, 27-9-46, JWG; 48532, 19-9-55; 65190, 25-9-59, JWG; 87505, 20-9-45, JWG. 16 reports.

*S. luteus* (L. ex Fr.) Gray 16840, 19-9-46, JWG. 3 reports.

*S. piperatus* (Bull. ex Fr). Kuntze 16370, 17-9-45; 16538, 8-9-45; 16801, 23-9-46, JWG; 16942, 18-9-46, JWG; 63358, 1-7-59, JWG. 20 reports.

*S. placidus* (Bon.) Sing. 84933, 20-9-49, WHS. 3 reports.

*S. punctipes* (Peck) Sing. 60223, 29-8-58, JWG; 87766, 22-9-49, JWG. 10 reports.

*S. rubinellus* (Peck) Sing. 16390, 17-9-45, ILC; 56586, 31-7-57, JWG. 14 reports.

*S. subluteus* (Peck) Snell 41387, 16-9-55, JWG; 59904, 2-9-58, JWG; 60203, 29-8-58, JWG; 60243, 26-8-58, JWG. 7 reports.

*Xerocomus badius* (Fr.) Kühner ex Gilb. 62062, 30-8-58, JWG; 65182, 9-9-59, JWG. 3 reports.

*X. illudens* (Peck) Sing. 56573, 27-7-57, JWG. 1 report.

*X. subtomentosus* (L. ex Fr.) Quél. 16910, 21-9-46, JWG; 56566, 26-7-57, JWG; 56600, 27-7-57, JWG; 59929, 1-9-58, JWG; 60477, 3-9-58, JWG. 16 reports.

The following species were reported but no specimens preserved; *Boletus bicolor* Peck (1); *B. luridus* Schaeff. ex Fr. (2); *B. speciosus* Frost (2); *Gomphidius flavipes* Peck (2); *G. maculatus* (Scop. ex Fr.) Fr. (8, and a painting); *Leccinum chromapes* (1); *L. testaceo-scabrum* (Secr.) Sing. (1); *Paragyrodon sphaerosporus* (Peck) Sing. (1); *Suillus subaureus* (Peck) Snell (3); *Tylopilus felleus* (Bull. ex Fr.) Karst. (18); *Xeroconus chrysenteron* (Bull. ex Fr.) Quél. (10).

## POLYPORACEAE

*Daedalea confragosa* Bolt. ex Fr. 73367, -55. 19 reports.

*Fomes annosus* (Fr.) Karst. 73385, -9-55, WHS. 2 reports.

*F. connatus* (Weinm.) Gill. 21079, -9-45. 19 reports.

*F. pini* (Fr.) Karst. 17036, 18-9-46, JWG; 17161, 18-7-46, RM. 9 reports.

*F. subroseus* (Weir) Overh. 17029, 27-9-46, RM. 6 reports.

*Ganoderma applanatum* (Pers. ex Wallr.) Pat. 10206, -8-41, MKN. 20 reports.

*L. trabea* Pers. ex Fr. 73428, 3-9-45, RP. 2 reports.

*Merulius tremellosus* Schrad. ex Fr. 73384, 21-9-52. 4 reports.

*Polyporus borealis* Fr. 53426, 26-8-59, RM; 73364, 28-8-52, WHS; 73371, -8-44; 73375, 6-8-43, RP. 7 reports.

*P. dryophilus* var. *vulpinus* (Fr.) Overh. 16547, 12-9-45, RM. 1 report.

*P. fibrillosus* Karst. 11250, 5-8-43; 73386, 8-8-54. 4 reports.

*P. griseus* Peck 52743, 26-7-57; 73363, 14-9-41, RM; 73369, 8-9-52, WHS. 5 reports.

*P. hirsutus* Wulf. ex Fr. 73368, 10-9-51, WHS. 8 reports.

*P. immitis* Peck 53425, 26-8-59, RM. 3 reports.

*P. melanopus* Fr. 73366, -55; 73373, 12-9-43, RM; 73379, 4-9-44; 73381, 13-9-47; 73403, 20-8-54. 11 reports.

*P. ovinus* Schaeff. ex Fr. 11765, -9-43, RM; 73103, 7-9-46, JWG. 14 reports.

*P. peckianus* Cooke 11768, -8-53, RM; 17037, 27-9-46, JWG; 73377, 5-9-48. 7 reports.

*P. picipes* Fr. 17035, 21-9-46. 15 reports.

*P. radiatus* Sow. ex Fr. 73383, 10-9-57, WHS. 2 reports.

*P. resinosus* Schrad. ex Fr. 21083, 17-9-45. 13 reports.

*P. schweinitzii* Fr. 73362, -7-42, WHS. 17 reports.

*P. subcartilagineus* Overh. 17976, 9-10-47, RM. 1 report.

*P. sulphureus* Bull. ex Fr. 73424, 16-7-54. 2 reports.

*P. tomentosus* Fr. 17030, 25-9-46, JWG; 21080, 6-9-45. 20 reports.

*P. tomentosus* var. *circinatus* (Fr.) Sartory & Maire 10247, -8-41, RM; 11617, -9-43; 73360, 20-8-41, WHS. 6 reports.

*P. umbellatus* Pers. ex Fr. 73398, 13-7-45; 73401, 1-8-47; 73402, 26-7-43. 5 reports.

*P. varius* Fr. 22371, 27-9-49, RM; 73427, 25-9-49, RM. 4 reports.

*P. versicolor* L. ex Fr. 11251, -8-43, RM. 17 reports.

*Trametes americana* Overh. 73365, 10-9-51, RM. 2 reports.

The following species were reported but no specimens preserved: *Daedalea quercina* L. ex Fr. (1); *D. unicolor* Bull. ex Fr. (18); *Favolus alveolaris* (DC. ex Fr.) Quél. (11); *Fomes fomentarius* (L. ex Fr.) Kickx (18); *F. igniarius* (L. ex Fr.) Kickx (17); *F. pinicola* (Sw. ex Fr.) Cooke (20); *F. roseus* (Alb. & Schw. ex Fr.) Karst. (17); *F. scutellatus* (Schw.) Cooke (5); *Ganoderma lucidum* (Leys. ex Fr.) Karst. (13); *Lenzites betulina* (L. ex Fr.) Fr. (16); *L. saepiaria* (Wulf. ex Fr.) Fr. (19); *Merulius lacrymans* Wulf. ex Fr. (3); *M. niveus* Fr. (1); *Polyporus abietinus* Dicks. ex Fr. (16); *P. adustus* Willd. ex Fr. (16); *P. albellus* Peck (15); *P. balsameus* Peck (2); *P. betulinus* Bull. ex Fr. (18); *P. biformis* Fr. (1); *P. brumalis* Pers. ex Fr. (13); *P. caesius* Schrad. ex Fr. (1); *P. cinnabarinus* Jacq. ex Fr. (16); *P. cinnamomeus* Jacq. ex Fr. (10); *P. conchifer* (Schw.) Fr. (1); *P. elegans* Bull. ex Fr. (20); *P. gilvus* (Schw.) Fr. (1); *P. glomeratus* Peck (3); *P. guttulatus* Peck (1); *P. montagnei* Fr. (1); *P. nidulans* Fr. (1); *P. pargamenus* Fr. (15); *P. perennis* L. ex Fr. (20); *P. pubescens* Schum. ex Fr. (1); *P. spumeus* Sow. ex Fr. (7); *P. tulipiferae* (Schw.) Overh. (15); *Poria aurea* Peck (1); *P. subacida* (Peck) Sacc. (1); *Trametes morgani* Lloyd (1).

HYDNACEAE

*Dentinum repandum* (Fr) S. F. Gray 16549, 12-9-45. 17 reports.
*Hericium coralloides* (Scop. ex Fr.) S. F. Gray 73412, 26-8-54. 1 report.
*Hydnellum aurantiacum* (Batsch ex Fr.) Karst. 11634, -9-43, RM; 52758, 3-8-57, Maas G; 73425, 5 & 7-8-45. 3 reports.
*H. diabolus* Banker 73417, 21-8-44. 14 reports.
*H. ferrugipes* Coker 10830, -8-41; 73414, 7-9-44, WHS. 14 reports.
*H. geogenium* (Fr.) Banker 10203, -8-41; 11633, 23-7-43; 16551, 8-9-45; 16798, 27-9-46, JWG; 52757, 1-8-57; 52761, 27-7-57; 73411, -9-43. 17 reports.
*H. mirabile* (Fr.) Karst. 73409, 9-9-51, WHS. 7 reports.
*H. scrobiculatum* var. *zonatum* (Batsch ex Fr.) Harrison 73431, 54. 11 reports.
*H. suaveolens* (Scop. ex Fr.) Karst. 10827, -8-41, RM; 11619, 20-7-43, RM; 52752, 1-8-57; 73430, 16-9-44, RM. 18 reports.
*H. velutinum* (Fr.) Karst. var. *velutinum* 11635, 23-7-43, RM; 73422, 9-8-45. 5 reports.
*Hydnum amarescens* Quél. 73408, 4-8-47, WHS; 73413, 7-8-44 & 19-9-44; 73418, -7-45, WHS. 7 reports.
*H. fennicum* (Karst.) Sacc. 73407, -9-43. 2 reports.
*H. imbricatum* L. ex Fr. 11637, 23-7-43; 16961, 27-9-46; 17134, 18-9-46; 52762, 1-8-57; 73406, 29-9-50; 73421, -9-43. 17 reports.
*H. laevigatum* Sw. ex Fr. 16556, -9-45, Maas G. 2 reports.
*H. stereosarcinon* (Wehmeyer) Harrison 16552, 8-9-43; 16907, 18-9-46, JWG; 16965, 16-9-46, JWG; 16968, 25-7-46, KAH; 52774, 27-7-57; 73423, -43, WHS. 18 reports.
*H. subfelleum* Harrison 73410, 28-8-54, WHS. 1 report.
*Phellodon delicatus* (Schw.) Banker 73434, 4-10-45. 4 reports.
*P. graveolens* (Delastre in Fr.) Banker 16550, 8-9-45; 16969, 18-9-46, JWG; 73415, 21-8-44 & 16-9-44, WHS; 73416, -9-44, WHS; 73419, 22-8-45. 7 reports.
*P. melaleucus* (Fr.) Karst. 11769, -8-43, KAH; 16915, 28-9-46, RM; 73432, 8-9-44, RM; 73433, 20-9-45, RM. 11 reports.
*P. strigoso-zonata* (Schw.) Lloyd 72319, -8-43, RM; 73376, 18-9-44; 73395, 6-9-45. 3 reports.
*Sistotrema confluens* Pers. ex Fr. 31212, 16-8-54, WHS; 73420, 15-4-54, WHS. 3 reports.
*Steccherinum ochraceum* (Pers. ex Fr.) S. F. Gray 73426, 10-9-45, RM. 3 reports.
*S. septentrionale* (Fr.) Banker 73405, 13-10-46. 10 reports.

The following species were reported but no specimens preserved: *Auriscalpium vulgare* Gray (1); *Hericium erinaceus* (Bull. ex Fr.) Pers. (2); *H. ramosum* (Bull. ex Merat) Letellier (1); *Hydnellum caeruleum* (Hornem. ex Pers.) Karst. (3); *H. ferrugineum* (Fr. ex Fr.) Karst. (2); *H. scrobiculatum* (Fr. ex Secr.) Karst. var. *scrobiculatum* (4); *Hydnochaete olivaceum* (Schw.) Banker (3); *Hydnum cristatum* Bres. (1); *H. fasciatum* Peck (1); *H. queletii* Fr. (1); *H. scabripes* Peck (1); *Phellodon niger* var. *alboniger* (Peck) Harrison (1); *Phlebia radiata* Fr. (1).

CLAVARIACEAE

*Clavaria abietina* Pers. *sensu* Coker 73387, 18-7-51. 4 reports.
*C. apiculata* Fr. 73391, 14-7-51. 2 reports.
*C. broomei* Cotton & Wakefield 73390, 13-9- ; 73404, 20-9-47. 5 reports.
*C. cristata* (Holmsk.) Pers. ex Fr. 73392, 3-9-51. 9 reports.
*C. fumosa* Pers. ex Fr. 21078, 18-9-45, ILC. 9 reports.
*C. fusiformis* Sow. ex Fr. 16819, 21-9-46, JWG. 10 reports.
*C. gracilis* Pers. ex Fr. 72411, 16-8-55. 1 report.
*C. kunzei* Fr. 73389, 27-7-45. 13 reports.
*C. ligula* Schaeff. ex Fr. 16807, 25-9-46, JWG. 17 reports.
*C. muscoides* L. ex Fr. 72407, 4-8-50; 72410, 22-8-52; 73396, 20-10-47. 7 reports.
*C. nigrita* Pers. *sensu* Coker 72734, 17-8-46. 1 report.
*C. pistillaris* L. ex Fr. 21085, 15-9-45. 12 reports.
*C. rosea* Fr. 72408, 20-7-50; 73393, 24-8-51; 73394, 11-7-42. 4 reports.
*C. suecica* Fr. 73388, 17-7-45. 10 reports.
*Lachnocladium semivestitum* B. & C. 73400, 24-8-54. 1 report.

The following species were reported but no specimens preserved: *Clavaria amethystina* (Batt.) Pers. sensu Coker (3); *C. angulispora* Pat. (1); *C. aurantio-cinnabarina* Schw. (1); *C. aurea* Schaeff. ex Fr. (12); *C. aurea* var. *australis* Coker (1); *C. botrytis* Pers. ex Fr. (8); *C. citriceps* Atk. (4); *C. cristata* f. *rugosa-krombholzii* Coker (2); *C. crocea* Pers. ex Fr. (5); *C. decurrens* var. *australis* Coker (1); *C. fistulosa* Holmsk. ex Fr. (1); *C. flava* Pers. ex Fr. (1); *C. flava* var. *subtilis* Coker (3); *C. formosa* Pers. ex Fr. (1); *C. longicaulis* Peck (6); *C. pulchra* Peck (8); *C. purpurea* Fr. (4); *C. pyxidata* Pers. ex Fr. (1); *C. sanguinea* Pers. sensu Coker (1); *C. stricta* Pers. sensu Coker (6); *C. subbotrytis* var. *intermedia* Coker (1); *C. vernicularis* Fr. (16); *C. vernalis* Schw. (2); *Lachnocladium palmatum* P. Henn. (1).

## THELEPHORACEAE

*Craterellus cornucopioides* (L. ex Fr.) Pers. 73382, 20-8-54. 2 reports.

*C. dubius* Peck 72606, 24-9-54, JWG; 72607, 7-9-51, JWG. 2 reports.

*C. taxophilus* Thom. 72849, 29-9-45, JWG. 4 reports.

*Peniophora rufa* (Fr.) Boid. 73380, 7-9-51, WHS. 2 reports.

*Solenia anomala* (Pers. ex Fr.) Fuckel 73361, 25-8-41, ILC. 1 report.

*Stereum hirsutum* (Willd. ex Fr.) S. F. Gray 73378, 20-7-41, WHS. 4 reports.

*Thelephora palmata* Fr. 31213, 8-9-54, RM; 73379, 21-7-51, RP. 3 reports.

*T. terrestris* Ehrh. ex Fr. 73370, -7-44; 73399, 15-7-41, HSJ. 10 reports.

The following species were reported but no specimens preserved: *Craterellus lutescens* Fr. (3); *Hymenochaete tabacina* (Sow. ex Fr.) Lév. (16); *Stereum complicatum* (Fr.) Fr. (16); *S. murraii* (Berk. & Curt.) Burt (1); *S. ostrea* (Blume & Nees ex Fr.) Fr. (1); *S. purpureum* (Pers. ex Fr.) Fr. (5); *S. striatum* (Fr.) Fr. (1); *Thelephora anthocephala* (Bull. ex Fr.) Fr. (1).

## TREMELLALES

*Auricularia auricularis* (Hook.) Underw. 72735, 26-8-40, JWG. 14 reports.

*Dacrymyces palmatus* (Schw.) Bres. 16851, 25-9-46, JWG. 20 reports.

*Guepinia spathularia* Fr. 16897, 18-9-46, JWG. 3 reports.

*Phlogiotis helvelloides* (Fr.) Martin 56537, 26-7-57, JWG; 73429, 2-9-41, WHS. 12 reports.

The following species were reported but no specimens preserved: *Calocera cornea* (Fr.) Loudon (4); *Pseudohydnum gelatinosum* (Fr.) Karst. (12); *Sebacina incrustans* (Fr.) Tul. (1); *Tremella lutescens* Fr. (15); *T. mycetophila* Peck (5); *T. versicaria* Bull. (5).

## GASTEROMYCETES

*Calvatia elata* (Massee) Morg. 87222, 1946. 5 reports.

*Crucibulum levis* (DC.) Kambly & Lee 16963, 17-9-46, JWG. 19 reports.

*Cyathus stercoreus* (Schw.) deToni 84618, -8-41. 3 reports.

*C. striatus* Pers. 84619, 2-8-50. 6 reports.

*Geastrum coronatum* Pers. 87223, 21-7-47. 5 reports.

*G. pectinatum* Pers. 84615, 29-9-50. 6 reports.

*G. rufescens* Pers. 84945, 17-9-49. 1 report.

*G. triplex* Jungh. 16778, 13-9-45, OP. 16911, 17946, JWG; 87100, 7-42. 14 reports.

*Lycoperdon coloratum* Peck 84616, 2-8-50. 6 reports.

*L. perlatum* Pers. 34328, 17-9-46, CAL. 18 reports.

*L. pyriforme* Pers. 16964, 17-9-46, JWG. 19 reports.

*L. subincarnatum* Peck 49637, 15-9-55, CAL. 1 report.

*Mutinus caninus* (Huds.) Fr. 65179, 25-9-59, JWG. 11 reports.

*Phallogaster saccatus* Morg. 87096, 9-8-41, JWG. 2 reports.

*Phallus ravenelii* Berk. & Curt. 16955, 18-9-46, JWG; 65180, 25-8-59, JWG. 8 reports.

The following species were reported but no specimens preserved: *Bovista pila* Berk. & Curt. (3); *Calvatia cyathiformis* (Bosc.)

Morg. (4); *C. gigantea* (Pers.) Lloyd (3); *Dictyophora duplicata* (Bosc.) E. Fischer (6); *Geastrum saccatum* Fr. (1); *G. velutinum* Morg. (2); *Lycoperdon curtisii* Berk. (2); *L. marginatum* Vitt. (13); *L. molle* Pers. (1); *L. muscorum* Morg. (1); *L. peckii* Morg. (1); *L. pedicellatum* Peck (6); *L. perlatum* var. *nigrescens* Pers. (1); *L. pusillum* Pers. (1); *L. rimulatum* Peck (1); *L. umbrinum* Pers. (13); *Scleroderma aurantium* Pers. (2); *Sphaerobolus stellatus* Pers. (1).

DISCOMYCETES (Operculatae)

*Aleuria rutilans* (Fr.) Gill. 15657, 13-9-45, ILC; 87357, 27-7-45. 3 reports.

*Aleurina atrovinosa* (Cooke) Seaver 60224, 26-8-58, JWG. 1 report.

*Bulgaria globosa* Fr. 84972, 1-6-49, JWG; 87209, 18-5-46; 87521, 12-5-45, FJS. 6 reports.

*B. melastoma* (Sow.) Seav. 56560, 31-7-57, JWG. 1 report.

*Discina convoluta* Seav. 87516, 1-6-45, JWG. 4 reports.

*Geopyxis cupularis* (L.) Sacc. 56595, 26-7-57, JWG. 1 report.

*Gyromitra infula* (Schaeff. ex Fr.) Quél. 87305, 12-9-46. 9 reports.

*Helvella crispa* (Scop.) Fr. 87206, 12-9-54. 1 report.

*H. elastica* Bull. ex Fr. 56651, 2-8-57, JWG; 84568, 16-8-50. 7 reports.

*Morchella angusticeps* Peck. 84975, 27-5-48; 84976, 1-6-49; 87212, 29-5-54. 4 reports.

*Otidea auricula* (Schaeff.) Rehm. 84973, 14-7-51; 87215, 26-7-47; 12325, 87523, 87531, 23-7-43. 6 reports.

*O. grandis* (Pers.) Mass. 64724, 6-9-59, JWG. 1 report.

*O. leporina* (Batsch) Fckl. 19317, 17-9-46, JWG; 64181, 6-9-59, JWG. 7 reports.

*Patella albida* (Schaeff.) Seav. 15646, 13-9-45, ILC; 64914, 6-9-59, JWG. 6 reports.

*P. scutellata* (L.) Morg. 15647, 12-9-45. 18 reports.

*Paxina acetabulum* (L.) Kuntze. 44794,1-9-54, JWG; 87216, 12-9-54, JWG. 2 reports.

*Peziza abietina* Pers. 19299, 21-9-44, JWG. 2 reports.

*P. brunneo-atra* Desm. 87218, 20-6-54. 3 reports.

*P. domiciliana* Cooke. 87524, 5-8-45. 3 reports.

*P. griseorosea* Ger. 19302, 21-9-46, JWG; 60239, 24-8-58, JWG. 5 reports.

*P. pustulata* (Hedw.) Pers. 87525, 1-6-45, JWG. 1 report.

*P. repanda* Pers. 15655, 13-9-45, ILC. 12 reports.

*P. succosa* Berk. 15682, 8-9-45, ILC; 19305, 21-9-46, JWG; 59949, 3-9-58, JWG; 61097, 3-8-57, JWG. 20 reports.

*P. vesiculosa* Bull. 56590, 5-8-57, JWG. 6 reports.

*Pseudoplectania nigrella* (Pers.) Fckl. 87527, 26-5-45. 3 reports.

The following species were reported but no specimens preserved: *Aleuria aurantia* (Pers.) Fckl. (5); *Discina ancilis* (Pers.) Sacc. (6); *Gyromitra esculenta* (Pers.) Fr. (18); *G. gigas* (Krombh.) Cooke, not reported but a drawing labelled *G. esculenta* appears to be this species; *Helvella lacunosa* Afz. ex Fr. (1); *Morchella esculenta* (L.) Pers. (2); *Paxina hispida* (Schaeff.) Seav. (8); *Peziza badia* Pers. (8); *P. fimeti* (Fckl.) Seav. (1); *P. melaleuca* (Bres.) Seav. (2); *P. proteana* (Boud.) Seav. (2); *P. sylvestris* (Boud.) Sacc. & Trott. (2); *P. violacea* Pers. (3); *Plectania coccinea* (Scop.) Fckl. (6); *Pseudoplectania fulgens* (Pers.) Fckl. (8).

DISCOMYCETES (Inoperculatae)

*Chlorosplenium versiformis* (Pers.) DeNot. 27623, 20-8-51, JWG; 87205, 21-9-46, JWG. 2 reports.

*Coryne sarcoides* (Jacq.) Tul. 19265, 21-9-46, JWG. 5 reports.

*Corynetes robustus* Durand. 19266, 27-9-46, JWG; 19267, 19-9-46, JWG; 50236, 16-9-55, JWG. 3 reports.

*Cudonia circinans* (Pers.) Fr. 19268, 17-9-41, JWG; 19269, 25-9-46, JWG; 84953, 31-8-51. 10 reports.

*C. lutea* (Peck) Sacc. 84952, 3-9-51. 9 reports.

*Dasyscyphus agassizii* (Berk. & Curt.) Sacc. 19274, 21-9-46, JWG. 15 reports.

*Geoglossum alveolatum* Durand. 15676, 15-9-45, JWG. 1 report.

*G. fallax* Durand. 15683, 13-9-45, ILC. 1 report.

*G. glabrum* Pers. 19283, 19-9-46, JWG. 3 reports.

*G. intermedium* Durand. 15544, 15-9-45, ILC. 1 report.

*G. nigritum* (Pers.) Cooke. 15545, 15673, 15679, 10-9-45, ILC; 15546, 15-9-45, ILC; 19284, 19-9-46, JWG. 6 reports.

*Gloeoglossum difforme* (Fr.) Durand. 15547, 10-9-45, ILC. 1 report.
*G. glutinosum* (Pers. ex Fr.) Durand. 15543, 10-9-45, ILC. 1 report.
*Helotium citrinum* (Hedw.) Fr. 15648, 15-9-45, ILC. 19 reports.
*H. fastidiosum* Peck. 19287, 23-9-46, JWG. 1 report.
*Kriegeria enterochroma* (Peck) Seav. 19260, 19-9-46, JWG. 1 report.
*Leotia lubrica* Scop.) Pers. 15555, 10-9-45, ILC; 84956, 14-9-52. 11 reports.
*L. stipitata* (Bosc.) Schroet. 19291, 19-9-46, JWG; 84958, 26-8-52. 5 reports.
*Microglossum rufum* (Schw.) Underw. 15568, 10-9-45, ILC; 19293, 19-9-46, JWG; 87386, 2-8-45. 11 reports.
*Mitrula irregularis* (Peck) Durand. 19294, 19-9-46, JWG. 13 reports.
*Spathularia clavata* (Schaeff.) Sacc. 19324, 2-8-45, JWG; 60252, 30-8-58, JWG; 84932, 30-8-51; 84970. 24-9-48. 12 reports.
*S. velutipes* Cooke & Farl. 87208, 25-9-46, JWG. 4 reports.
*Trichoglossum hirsutum* (Pers.) Boud. 15017, 10-9-45, ILC; 15018, 15-9-45, ILC; 19329, 19-9-46, JWG. 4 reports.
*T. velutipes* (Peck) Durand. 15619, 10-9-45, ILC; 15620, 15-9-45, ILC, 19330, 19331, 19-9-46, JWG. 4 reports.
*T. walteri* (Berk.) Durand. 19187, 17-9-45, ILC. 2 reports.

The following species were reported but no specimens preserved; *Chlorosplenium aeruginascens* (Nyl.) Karst. (4); *C. aeruginosum* (Oed. ex Gray) DeNot. (6); *Mitrula phalloides* (Bull.) Chev. (1); *Stictis radiata* (L.) Pers. (1): *Trichoglossum wrightii* Durand (1).

Received for publication 10 April 1963

## LE CERCLE DES NATURALISTES VISETOIS

The Secretary has received a letter from Monsieur J. M. Warlet, the founder of le Cercle des "Naturalistes Visétois", a group of amateur naturalists in Warsage, Belgium, proposing exchanges of plant and insect specimens between members of his organization and those of The Ottawa Field-Naturalists' Club. He mentions particularly pteridophytes, bryophytes, lichens, Coleoptera and Lepidoptera as groups of interest to his colleagues. Anyone interested in exchanging specimens is urged to write to:

Monsieur J. M. Warlet,
Agronome Colonial
La Maillère No. 3
WARSAGE (Prov. Liège)
BELGIQUE.

# THE HERPETOFAUNA OF SOUTHEASTERN ALBERTA

VICTOR LEWIN
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Edmonton, Alberta, Canada.

THE VERTEBRATE FAUNA of the southeastern part of Alberta contains many forms whose distribution, ecological relationship, and systematic status are poorly known. Consequently a faunal survey of this area was undertaken during the summers of 1961 and 1962.

In the spring of 1961 from May 14 through May 19, the author and three students, Denis Fillion, Richard Gallimore and Robert Walker, collected in this area and during the following spring from May 29 through June 19, another party worked this area. This party consisted of the author and two assistants, John Ryder and Robert Walker. During this period we were assisted by Dr. J. Dewey Soper and during the last week by Dr. J. R. Nursall and Dr. R. Hartland-Rowe. During both of these seasons the camps were located at the bottom of the Milk River canyon, seventeen miles west of Wildhorse. At this location the Milk River dips for the second time into Montana.

An attempt was made to bring together specimens and notes collected in previous years from this area. Dr. J. E. Moore and Mr. R. Lister of the Department of Zoology collected many amphibians and reptiles from southeastern Alberta during the summers of 1950 and 1951 and the latter collected in this area again in 1955.

I am grateful to the personnel of the Manyberries Experimental Farm for the services and information given to the several collecting parties. Special thanks are due to the director, Dr. H. Peters for making the facilities of this research station available to us and to Mr. S. Smoliak who gave us detailed information on local conditions and who has for many years collected and donated vertebrate specimens to this Department.

The hospitality of the ranchers of southeastern Alberta made field work a pleasure. Special thanks are due to the late Mr. Sidney Dann who aided early expeditions in the Pakowki Lake area and to Mr. George Ross who provided our recent party with a headquarters building in the Milk River canyon.

I am indebted to Dr. R. G. H. Cormack of the Department of Botany of the University of Alberta for the identification of our collection of plants from the area and to Mr. F. R. Cook, Curator of Herpetology of the National Museum of Canada who kindly supplied the racial designations of the specimens.

Dr. G. E. Ball and Mr. R. Lister read the manuscript and the latter provided much information on the habitat preferences of these animals.

The study area lies in the extreme southeastern corner of Alberta and includes townships 1 to 7, ranges 1 to 12 west of the 4th meridian (Figure 1). The area is thus eighty-four townships or 3,024 square miles.

In general this area is of undulating to gently rolling topography cut in many areas by deeply eroded coulees. Prominent land marks of the area include the southern part of the Cypress Hills plateau which rises to 4,800 feet.

According to Wyatt and Newton (1941) this plateau actually represents a pre-glacial plain of Tertiary age and is devoid of any evidence of glaciation. All of the geological surface formations which occur on the remainder of the study area are of glacial or post glacial origin and are Upper Cretaceous in age. The foothills of the Sweet Grass Hills which rise to over 5,000 feet in Montana enter the study area while still at elevations of nearly 4,000 feet and extend a short way into the extreme southwestern corner of the area.

Forty Mile and Chin coulees join in the northwestern corner of the area to form Seven Persons Coulee which is at the lowest elevation of the area, slightly over 2,500 feet, as it leaves to the north. Wyatt and Newton (1941) also claim that these large coulees represent drainage courses which formed along the front of the retreating ice sheet that covered this entire area with the exception of the Cypress Hills plateau. These large coulees in the northwest are drainage streams of the Hudson Bay Basin.

Pakowki Lake, a major feature in the central part of this area, has in the past supported a large number of waterfowl as well as numerous amphibians but is at present dry. This lake and its former tributary, Etzikom Coulee, represent an internal drainage basin although it is believed to have formerly drained via Pendant d'Oreille Coulee into the Milk River.

The most prominent feature of the southern part of the area is the Milk River which flows eastward and enters Montana in Range 5 at slightly over 2,700 feet of elevation. This river has cut deeply through the post glacial plain and in places the canyon is about a mile wide and its walls rise to over 400 feet. There are many eroded side canyons; one of the most spectacular on the north side is Lost River Coulee. This river is the most active drainage in the area at present but the size of the valley in which it meanders indicates that it was much more active in the past. The Milk River enters the Missouri River and is thus in the Mississippi Basin, a fact which is of considerable interest as it provides a possible avenue of migration to many vertebrates which would otherwise not be afforded the opportunity of northward range extensions into Alberta.

The surface geology is of interest as it bears on the nature of the soils of the area, especially with reference to texture and color, as these affect the local distribution as well as the color pattern of many of the vertebrates. Soil fertility affects distribution and abundance indirectly and must also be considered.

The description of the surface geology of the area proceeds from the oldest formation and follows the terminology of Russell and Landes (1940).

The Pakowki formation surfaces in the upper reaches of the Milk River canyon and is confined to about four townships in the southwestern corner of the area. It is mostly soft dark marine shale in which slumping is common and in which badlands form readily.

The Foremost formation comes to the surface generally in the western part of the area and in the plains surrounding Pakowki Lake and also on the canyon walls on the lower reaches of the Milk River. It is composed of sandstone and drab shale with coal seams. The color varies from gray to reddish or yellowish.

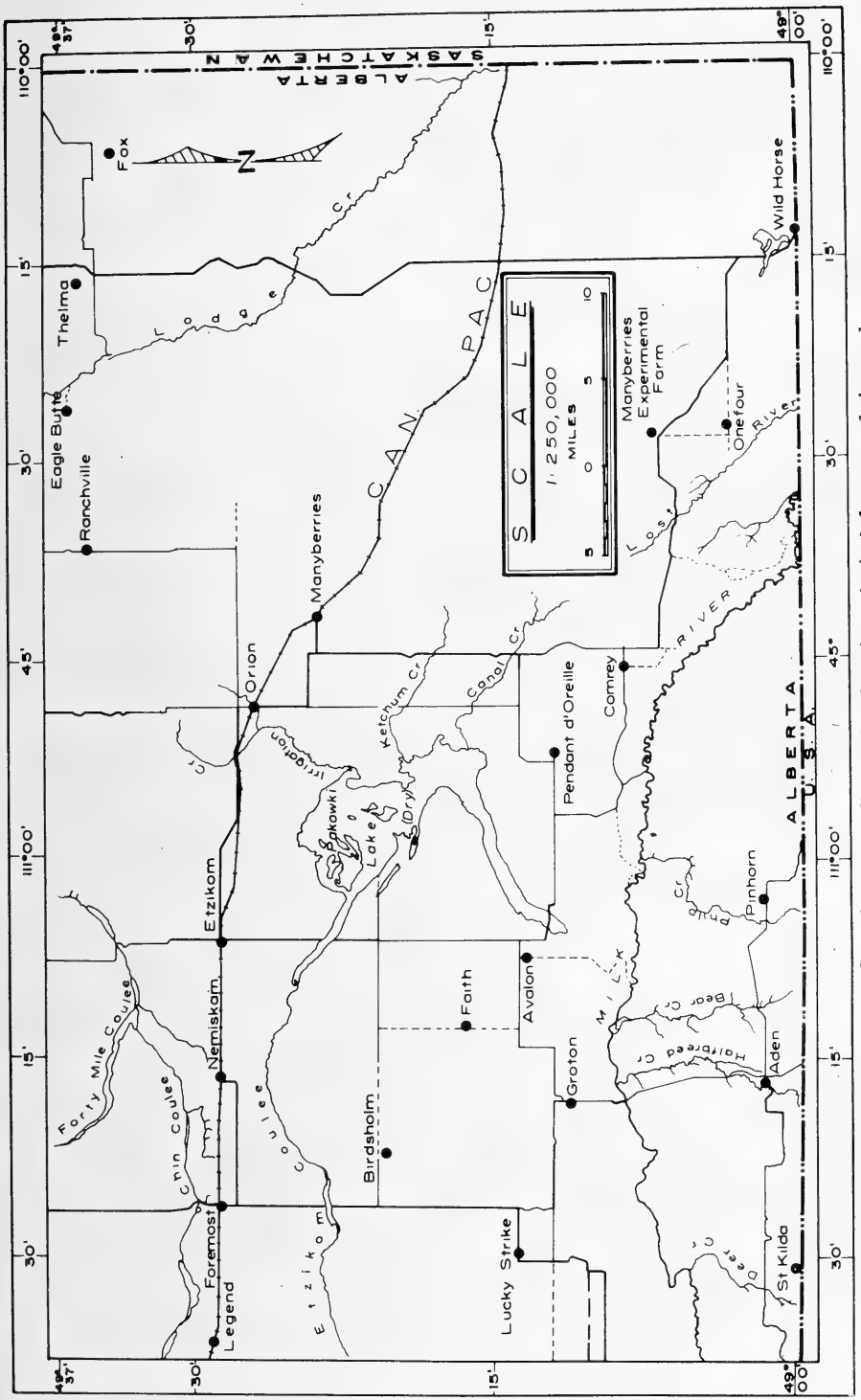


FIGURE 1. Map of southeastern Alberta showing the principal features of the study area.

The Oldman formation is found generally in the southeastern corner of the area and extends northwest as an eight mile strip through Orion to the northern border of the area. This material is composed of light colored shales and sandstones. Individual beds of this formation may also vary from pale gray to dark brown. Remains of a large dinosaur were found in this formation at the top of Lost River Coulee south of Onefour.

The Bearpaw formation extends as a wide band from twelve to twenty miles wide from the base of the Cypress Hills. It is composed of gray marine shales, at times sandy, which weather commonly to a rusty color and less commonly to yellowish or indigo blue.

The Eastend formation forms a narrow fringe at the base of the main escarpment of the Cypress Hills and at Eagle Butte and is composed of light colored sandstone and shale with coal seams.

The Ravenscrag formation forms the steep slopes of the Cypress Hills and is predominantly a buff colored crossbedded sandstone.

The Cypress Hills formation caps the Cypress Hills plateau and is composed of a light colored conglomerate, the matrix of which is sandstone.

The general impression of both the rocky outcroppings and the soils of the region which are of the brown type, is one of both lightness of color and texture. The sandy nature and consequent porosity of the soil is also widespread. To be sure there are dark beds, especially along the canyon walls, but they are thin and do not diminish the general lightness of the background. In addition the alluvial soil in the coulee bottoms and in the bottom of the Milk River canyon is light colored, sandy and erodes rapidly at times of high water.

A general impression of soil fertility may be obtained by a brief resumé of the pattern of land use. The latest soil survey by Wyatt and Newton (1941) shows cultivation to be almost entirely restricted to the northwestern quarter of the area where wheat is the predominant crop but some oats and very little barley and rye are also grown. There are small local areas in other sections which grow wheat successfully. Notably among these in the Aden district is an area on the east side of Pakowki Lake and in the Comrey district. The remainder of the area, approximately 2,500 square miles, is short grass prairie most of which is used as grazing land by the large ranches of this area.

The climate of this area is semi-arid and is typical of the high plains region of Western Canada. The long term average annual precipitation at Manyberries is given by the Dominion Meteorological Branch, (1959) as 11.05 inches. Most of the precipitation occurs as rain during the summer months. Both the duration and depth of snow are minimal relative to Alberta as a whole. The mean annual number of days with snow cover of one inch or more is 80 to 100 in extreme southeastern Alberta. This compares with 120 to 140 days in the Edmonton region, (Atlas of Canada, 1957).

The area is one of low relative humidity with consequently a high evaporation rate. Boughner and Thomas (1948) provide data from Medicine Hat indicating that the relative humidity is lowest during the summer, being between 56 and 64 and highest during the winter, between 80 and 83. As a comparison the relative humidity in Edmonton during the winter is not signi-

ficantly different than at Medicine Hat but the summer humidity is much greater being between 68 and 71.

The long term temperature records at Manyberries, provided by the Dominion Meteorological Branch (1959) indicate the annual mean temperature to be 40.1°F. The comparable figure for Edmonton is 36.8°F. The mean temperature of January at Manyberries is 10.8°F. and that of July is 68.5°F. Comparable figures for Edmonton are 7.7°F. and 62.9°F.

Chinook winds are common in this area during winter as well as summer. These strong warm air masses form long cloud arches originating usually to the westward and melt the snow cover during the winter or cause crop damage if they occur during the growing season.

The extensive network of canyons and coulees that dissect the gently undulating prairie of this area provide for a diversity of plant types. Amphibians and reptiles were found in all of the five major habitats of this region.

The short grass prairie habitat is of course the most widespread in the region and was found to be the least desirable to the herpetofauna generally with the exception of areas lying next to either canyon rims or ponds. The most common grasses of the prairie in regions adjacent to the Milk River are June grass (*Koeleria cristata*), northern wheat grass (*Agropyron dasystachyum*), sand grass (*Calamovilfa longifolia*), and bluegrass (*Poa cusickii*). The sedge (*Carex eleocharis*) and the prairie onion (*Allium textile*) are common. The yellow umbrella-plant (*Eriogonum flavum*), lamb's quarters (*Chenopodium album*), narrow-leaved goosefoot (*C. leptophyllum*), and winter fat (*Eurotia lanata*) are widespread. The Russian thistle (*Salsola kali*) is particularly common on overgrazed pastures, road sides and on any disturbed areas. The old plants roll along the prairie and pile up in deep layers along fences and in ditches providing cover for snakes on the otherwise open grassland. Flixweed (*Descurainia sophia*), common peppergrass (*Lepidium densiflorum*), loco-weed (*Oxytropus* sp.), golden bean (*Thermopsis rhombifolia*), and scarlet mallow (*Sphaeralcea coccinea*) are also common on roadsides. Mats of prickly pear cactus (*Opuntia polycantha*), and single and small groups of the small cushion or ball cactus (*Mamillaria vivipara*) are widespread in this habitat and also common on the sage flats adjacent to the rivers and in the coulee bottoms. Scarlet butterfly-weed (*Gaura coccinea*), moss phlox (*Phlox hoodii*), stick-tights (*Lappula redowskii*), white beard-tongue (*Penstemon albidus*), wild daisy (*Erigeron caespitosus*), and prairie groundsel (*Senecio canus*) are also common plants of the short grass prairie.

The rocky side canyon and coulee rim areas constitute a distinct habitat characterized by much bare and eroding soil with scattered rocks some of which are very large (Figure 2B. The spaces between boulders is often covered with a thick mat of creeping juniper (*Juniperus horizontalis*). The silver-berry or wolf willow (*Elaeagnus commutata*) is a common plant of this area. The bladder fern (*Cystopteris fragilis*) is occasionally found in protected side canyons where there is some water seepage and where a canopy, commonly of red osier dogwood (*Cornus stolonifera*), is available.

The sagebrush habitat is most luxuriant in the extensive flat areas of alluvial soil adjacent to the Milk River and in some of the other larger coulees of the area. Salt sage (*Atriplex nuttallii*), and sagebrush (*Artemesia cana*) are common. Winter fat and Russian thistle are also common inhabitants of this area.

The large western cottonwood (*Populus sargentii*) and its understory form a rich vegetation belt most extensively developed along permanent water courses.

This vegetation type is most luxuriant along the Milk River where it meanders through its deep canyon in the southeast part of the area (Figure 2A). Both tree and shrub willows (*Salix* sp.), golden currant (*Ribes aureum*), common wild rose (*Rosa woodsii*), Russian olive (*Elaeagnus angustifolia*), buckbrush (*Symphoricarpos occidentalis*), and red osier dogwood form the dense thorny understory beneath the large cottonwoods. In places large areas of some of these shrubs, especially wild rose and Russian olive occur as thick stands which alternate with the cottonwood stands especially in the canyon of the Milk River (Figures 2C and 2D).

The natural pond and small lake areas support a lush vegetation as well as an abundant herpetofauna. Most natural ponds dry up during the summer and indeed many may be present only during a wet series of years. Of particular interest are the oxbow ponds, small crescentic bodies of water found in the Milk River canyon which are transient remnants of former meanders. Only two oxbow ponds are present in this canyon, both located within two miles of the forty-ninth parallel but within the next few years there will be another one five miles south of Pendant d'Oreille, as the river in this place doubles back on itself and is separated by only four feet of sandy soil. This oxbow will be very large and will offer an unparalleled opportunity of collecting the aquatic members of the herpetofauna as well as affording excellent conditions for collecting fish which are poorly known from this region.

The common emergent plant species of the ponds in the region are common cattail (*Typha latifolia*), sedge (*Carex atherodes*), spike rush (*Eleocharis palustrus*) and common great bulrush (*Scirpus validus*).

A new narcotizing agent, tribromoethanol (available from Winthrop Laboratories, New York) was used to kill and relax both amphibians and reptiles. Amphibians were placed in a saturated aqueous solution prepared simply by placing a small pinch of this chemical in a jar of water. The reptiles

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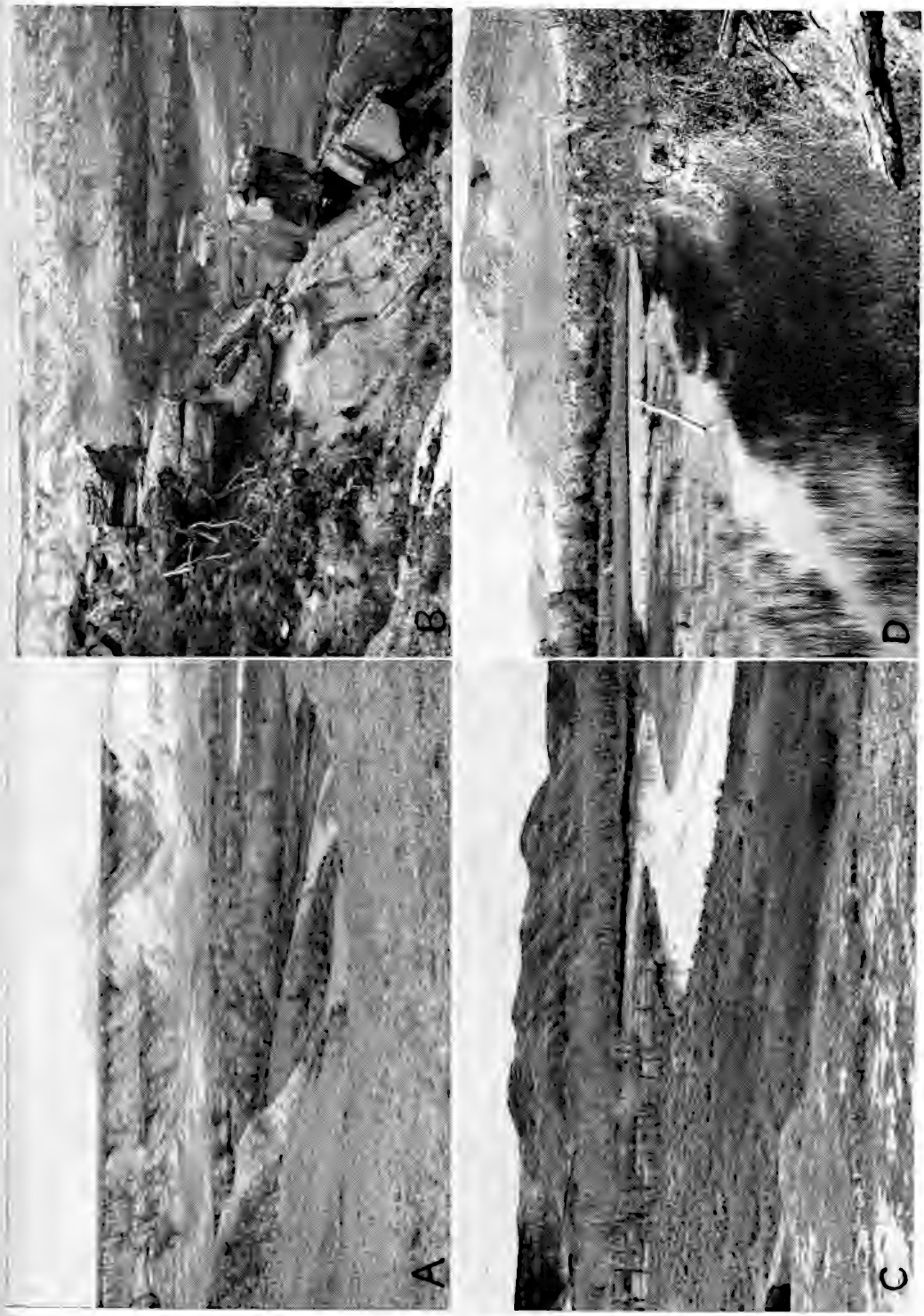
FIGURE 2. Habitats in the study area.

A. The Milk River Canyon, 18 miles west of Wildhorse showing one of the few oxbow ponds of this area. Short-horned lizards were found on the Canyon rim and adjacent prairie. Photo June 3, 1962.

B. Both the prairie rattlesnake and plains hog-nosed snake were collected in the juniper-grassland habitat between large boulders on the upper canyon rim of the Milk River. Photo June 3, 1962.

C. The 1961 camp site located near extensive sage flats, 17 miles west of Wildhorse, where rattlesnakes and bullsnakes were most commonly found. Photo May 16, 1961.

D. One of the western painted turtles was collected from the basking log in this oxbow pond. Leopard and chorus frogs, tiger salamanders, garter and rattlesnakes were common inhabitants of this area. Photo June 17, 1962.


A
B
C
D

were injected with a saturated solution of tribromoethanol in twenty percent ethyl alcohol. One to three milliliters were injected in the anterior third of the body of small snakes and three to six milliliters were used in the larger forms. All animals were dead and completely relaxed within one or two minutes.

## ACCOUNTS OF SPECIES

The list includes all extant species of amphibians and reptiles which have been found in the 3,024 square mile area in the southeastern corner of Alberta. The sequence and the common and scientific names are according to Logier and Toner (1961) except the trinomial for the boreal chorus frog which follows Schwartz (1957) and the trinomial for the bullsnake which is according to Conant (1956). The number of specimens, the date and each locality is given. The specimens collected are preserved in the University of Alberta, Museum of Zoology.

*Ambystoma tigrinum melanostictum* Baird BLOTCHED TIGER SALAMANDER. 9, 4 mi. N. Onefour, Aug. 28-Sept. 2, 1950, 1951, 1953; 5, Manyberries, Aug. 21, 1950; 3, Orion, Aug. 9-15, 1951, 1954; 2, 12 mi. S. Cypress Hills, Aug. 1950; 1, Aden, Aug. 16, 1951; 1, Eagle Butte, Sept. 1951; 141, Pakowki Lake, 11 mi. W. Manyberries, Aug. 9, 1951; 54, Milk River, 17 mi. W. Wildhorse, June 19, 1962. Total specimens, 216.

Tiger salamanders are common in both temporary and permanent lakes, ponds and even in roadside ditches. They have been recovered also from open wells, root cellars and in moist basements in the area.

The series of 141 salamanders from Pakowki Lake was collected following rainy weather within 100 yards of the shore from under moist hay swaths. This series represents recently emerged animals as in every case a remnant of the gills which varied from one to a few millimeters in length was still present. The frequency distribution of the total length of these emergents, as shown in Figure 3, indicates that they constitute a single age class.

*Scaphiopus bombifrons* Cope PLAINS SPADEFOOT. 91, Orion, May 20-Aug. 21, 1950, 1951, 1955; 30, St. Kilda, Aug. 14, 1951; Total specimens, 121.

A common toad in the area, although it is seldom seen during the day. It evidently breeds during the latter half of May in permanent water and is also found in the outflow areas of artesian wells or in larger ponds. Pairs were seen by R. Lister in amplexus on May 20, 1955 and other breeding toads were collected from permanent water by S. H. Dann in previous years during the last week of May. However, the differences in the stages of development of young toads collected from temporary ponds and roadside ditches indicate that these animals are adventitious breeders, adapted to take advantage of the transitory ponds provided by the variable pattern of spring rainfall. The variation in breeding from one year to the next is illustrated by 40 immature specimens from Orion in 1950 and 30 from St. Kilda collected the following year. All of the Orion specimens retain remnants of the tail, and average 19 millimeters in head-body length and were taken on August 21. The St. Kilda toads have completed metamorphosis, average 28 millimeters in length but were collected on August 14.

Other records of this toad from southeastern Alberta are provided by Moore (1952) who collected young from Gleichen, Barons, Taber and Verdigris Coulee. Divergent developmental stages of these specimens also attest to the adventitious breeding behavior of this toad.

*Bufo cognatus* Say GREAT PLAINS TOAD. Lost River, S. Onefour, Aug. 19, 1950. One specimen.

A rare toad in the area judging from the very few specimens collected. There are only seven Alberta specimens from six localities and only one of these is from the extreme southeastern corner of Alberta. Logier (1931) was the first to record this species in Alberta, from Medicine Hat, and Moore (1953a) mentions that the other localities are Empress, Suffield, Taber and Vauxhall.

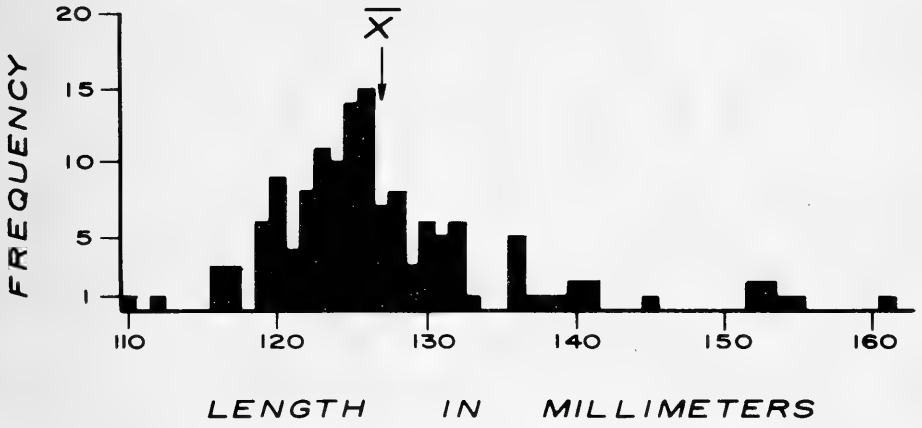



FIGURE 3. Frequency distribution of total length of tiger salamanders on emerging from Pakowki Lake in 1951. The X indicates the average length.

*Pseudacris triseriata maculata* Agassiz BOREAL CHORUS FROG. 1, Thelma, May 1, 1950; 2, St. Kilda, Aug. 15, 1951; 2, Aden, Aug. 16, 1951; 1, Manyberries, Aug. 21, 1950; 10, Etzikom Coulee, 6 mi. S. Foremost, Aug. 11, 1951; 6, Wildhorse, Aug. 7, 1951; 2, Eagle Butte, Aug. 5, 1951; 21, Orion, Aug. 10-21, 1950, 1951; 8, 4 mi. N. Onefour, Aug. 19, 1950, 1951; 45, Milk River, 17 mi. W. Wildhorse, May 18-June 19, 1961, 1962. Total specimens, 98.

A very common frog in both temporary and permanent ponds in the area.

*Rana pipiens* Schreber LEOPARD FROG. 1, St. Kilda, Aug. 14, 1951; 3, Eagle Butte, Aug. 5, 1951; 1, Thelma, May 1, 1950; 5, 4 mi. N. Onefour, 1951; 64, Milk River, 17 mi. W. Wildhorse, May 16-June 19, 1961, 1962. Total specimens, 74.

A very common resident which is more restricted to permanent water than is the boreal chorus frog. This large frog is commonly found in the larger ponds and streams in the area. Breeding adult leopard frogs were collected from an oxbow and another small pond in the Milk River canyon during the latter half of May and in the first week in June. In the spring the smaller pond contained only a foot of water and four feet was the maximum depth of the larger one. These ponds were revisited on November 10, 1962 and were found to be dry. Both ponds support a luxuriant growth of rushes and cattails and are within a hundred feet of the Milk River.

*Chrysemys picta belli* Gray WESTERN PAINTED TURTLE. Milk River, 17 mi. W. Wildhorse, June 6-19, 1962. Total specimens, 3.

No previous records of this species are listed for Alberta by Logier and Toner 1961. Although both Conant (1958) and Stebbins (1954) suggest the occurrence of western painted turtles in their distribution maps, no locality designations are indicated.

Some pertinent data on the turtles are given in Table 1.

The turtles were found in one of the oxbow ponds which occur adjacent to the Milk River. The pond contained much emergent vegetation primarily bulrushes, cattails and sedges and had several large partly submerged tree trunks which were used by the turtles for basking (Figure 2D).

There have been several other reports of turtles in Alberta during past years. Upon investigation, all of these have been attributed to human introductions. This population of turtles on the Milk River is almost certainly a natural one as this locality is remote from human habitation and is six miles from the nearest public road. In addition, there are many scratches on the three basking logs just above the water level. Some of these claw marks, which were made by the turtles in their efforts to climb onto the logs, were old and indistinct indicating usage of this pond over a long period.

TABLE 1—MEASUREMENTS *of Chrysemys picta belli*

| | | | Carapace | | Plastron | |
|---|---|---|---|---|---|---|
| U.A.M.Z. | Date | Sex | Length | Width | Length | Width |
| 255 | June 6, 1962 | ♀ | 21.9 cm. | 16.5 cm. | 20.0 cm. | 10.8 cm. |
| 256 | June 7, 1962 | ♀ | 21.1 | 16.2 | 20.6 | 11.6 |
| 257 | June 19, 1962 | ♂ | 13.7 | 11.3 | 12.7 | 5.9 |

*Phrynosoma douglassi brevirostre* Girard EASTERN SHORT-HORNED LIZARD. 1, Foremost, May 28, 1950; 1, Comrey, June 26, 1953; 8, Lost River, 2 mi. W. Onefour, May 27-Aug. 20, 1950, 1951; 5, Manyberries, June 10-Aug. 3, 1951, 1953; 4, 4½ mi. N. Onefour, July, 1959; 1, 2 mi. W. 1 mi. N. Wildhorse, May 30, 1962; 1, 11 mi. W. 3 mi. N. Wildhorse, June 17, 1962. Total specimens, 21.

A comparatively scarce reptile of the area but definitely most common in the vicinity of coulees. Some have been found on the shortgrass prairie within a hundred yards of coulee rims but these lizards seem to prefer the rocky upper reaches of the canyon rims where they may be found on sandstone ledges or under overhanging banks.

Horned lizards were also found by Williams (1946) in Chin Coulee near Foremost, and at Bear Gulch near Aden. Williams suggests that Chin, Centre, Etzikom and Verdigris Coulees as well as the Milk River and its present tributaries served as northward migration paths for horned lizards. These water courses were evidently formed when the Wisconsin Ice Sheet made its final retreat. Perhaps these waterways did serve as northward migration routes for horned lizards managed somehow in the not too distant past to cross into the South Saskatchewan drainage basin to the north as they are also known to occur in the Medicine Hat area.

*Thamnophis elegans vagrans* Baird and Girard WANDERING GARTER SNAKE. 1, Eagle Butte, Aug. 6, 1951; 1, St. Kilda, Aug. 14, 1951; 1, 4 mi. N. Onefour, "fall" 1955; 2, 17 mi. W. 1 mi. N. Wildhorse, June 3-6, 1962. Total specimens, 5.

A common snake but apparently somewhat restricted to water courses and brushy coulee bottom lands.

*Thamnophis radix haydeni* Kennicott WESTERN PLAINS GARTER SNAKE. 1, Etzikom Coulee, 6 mi. S. Foremost, Aug. 11, 1951; 2, 4 mi. N. Onefour, Aug., 1950, 1951; 1, Wildhorse, Aug. 7, 1951. Total specimens, 4.

A common snake widely distributed over the short grass prairie but particularly abundant in the neighbourhood of ponds and coulees.

*Heterodon nasicus nasicus* Baird and Girard PLAINS HOG-NOSED SNAKE. 1, Comrey, July 2, 1938; 1, 20 mi. W. 2½ mi. N. Wildhorse, June 15, 1962; 1, 13 mi. W. 5½ mi. N. Wildhorse, July, 1961. Total specimens, 3.

A very rare snake. Including our 1962 specimen this species is only known from six localities in Alberta. Moore (1953b) summarizes the knowledge of this snake in Alberta and states a habitat preference of "sandy locations and also damp lowlands". Our specimen was captured while in a coiled position in short grass surrounded by large rocks and prostrate juniper bushes. The area was on the south facing slope and at the first step at the top of the Milk River canyon rim. This snake made no attempt to feign death nor did it become limp when captured. In fact it struck several times as it tried to escape.

A specimen collected on July 13, 1951 at Empress by Lister and Moore puffed itself up, hissed, then remained upside down in the hand.

*Pituophis melanoleucus sayi* Schlegel BULL-SNAKE. 1, Foremost, Aug. 15, 1940; 1, Milk River, 17 mi. W. Wildsorse, June 1, 1962; 1, Milk River, 23 mi. W., 8 mi. N. Wildhorse, June 4, 1962; 1, 26 mi. W., 10 mi. N. Wildhorse, June 13, 1962. Total specimens, 4.

A relatively common snake in brushy coulees, sage flats and along roads especially where dried Russian thistle has piled high in the side ditches and along fences.

*Crotalus viridis viridis* Rafinesque PRAIRIE RATTLESNAKE. 3, 4 mi. N. Onefour, June-Aug. 7, 1951, 1957; 1, Milk River, 17 mi. W. Wildhorse, June 2, 1962; 2, Milk River, 17 mi. W., 1 mi. N. Wildhorse, June 2-16, 1962. Total specimens, 6.

Noticeably most common in river and coulee bottoms and in brushy borders of ponds. Also common on sage flats near the Milk River, less common in side canyons and upper canyon rims adjacent to prairie, and scarce on the open short grass prairie. Found also around windbreaks near ranch buildings and several have been seen in planted vegetation belts around the Manyberries Experimental Farm.

## SUMMARY

The arid short grass prairie region of the extreme southeastern corner of Alberta has received only passing mention from zoologists. Since this is the first treatment of the herpetofauna of the region, a detailed description of the geology, botany, climate and pattern of land use is provided. In addition, early specimen records are included with the recent material which was collected during the springs of 1961 and 1962.

The localities, dates, habitat preferences, relative abundance as well as comments on ecology and behavior are provided for the 556 specimens which have been collected from the 3,024 square mile study area during the past 25 years.

Five amphibian and seven reptilian species make up the herpetofauna of this region. All of the amphibians, the western painted turtle, and both the wandering and western plains garter snakes are either restricted to water or associated with water margin habitats. The eastern short-horned lizard, bullsnake and prairie rattlesnake are found on the rolling short grass prairie but are most abundant in the river or coulee bottom lands and side canyons. No generalizations can be made regarding the habitat preference or relative abundance of the plains hog-nosed snake due to its scarcity.

The three western painted turtle specimens represent a westward range extension of 125 miles and an eastward extension of 200 miles. These are the first records of a naturally occuring turtle population in the province of Alberta.

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# PUZZLING CLAY TUBES FROM THE SEA BOTTOM

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## WHAT AND WHERE THEY ARE

SAMPLES OF WHAT I have called clay tubes, for want of a better name, are shown in Figures 1 and 2. They were first described to me in March 1950 by the late Clyde Taylor. He was then on the staff of the Boothbay Harbor laboratory of the Maine Department of Sea and Shore Fisheries. They were first shown to me on March 26, 1950, by Capt. Ralph E. Wooster from Camden, Maine, when we were fishing sea scallops, *Placopecten magellanicus* Gmelin, in Penobscot Bay.

In the course of the day we found several specimens (including two illustrated in Figure 1) at a depth of 20 to 30 metres on a scallop bed near Monroe's Island in the southwestern part of the Bay (N. Lat. 44°5′; W. Long. 69°2′). He was using Digby, N.S.-type dredges (MacPhail, 1954) that scrape the bottom without digging in except where it is quite soft.

Most of the specimens seemed to be broken sections (ends often angular) of longer straight clay tubes. One (Figure 1 and No. 2 in Table 1) was forked but both of the branches of this specimen were broken off just beyond the fork. The thickness of the walls varied a good deal because the outer surfaces were irregular. In contrast, the inner faces were quite uniform and relatively, but not perfectly, smooth. The bore of most tubes was uniform throughout but in a few cases it flared at one end and in one specimen it tapered gently at one end to half its diameter (Figure 2).

The specific gravity of fresh tubes varied about 2.0. Their walls were firm but usually soft enough to score with the thumb nail. They were rigid

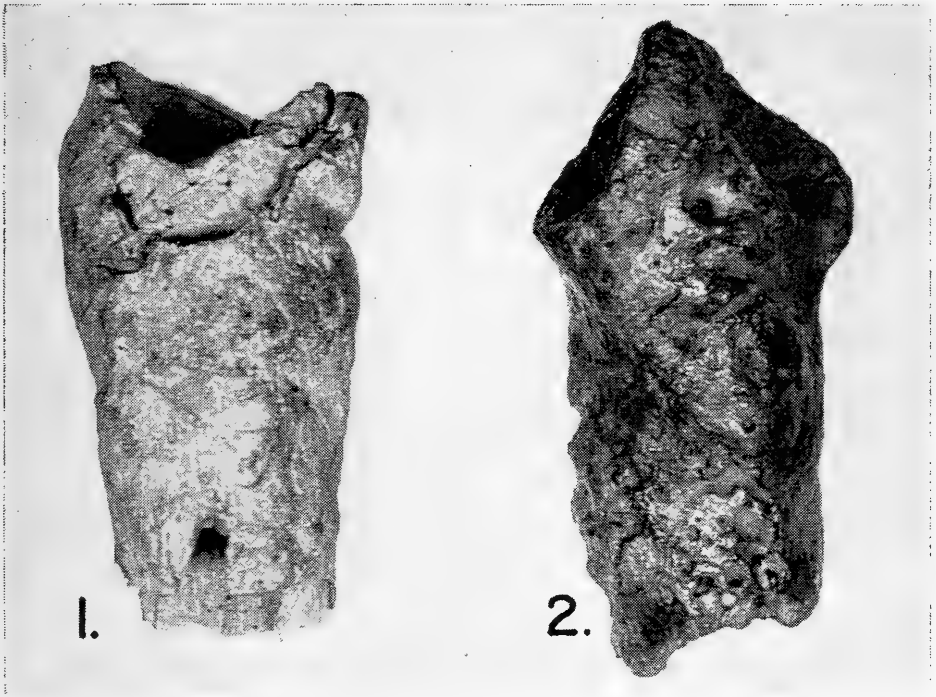


FIGURE 1. Penobscot Bay tubes collected 1950 showing unbranched and branched forms. No. 2 also shows evidence of epiphytic growths.

and under pressure broke into large angular fragments. On drying, the tubes checked and finally broke in the same fashion even without pressure. When fresh from the water, they were the colour of a scuffed black shoe but they dried to a dirty gray.

The broken ends of the walls showed evidence of concentric structural build-up with rusty curved lines here and there as if there had been some mineral deposit. But the main substance of the tubes seemed to be inert clay. There was no effervescence under acids of various kinds.

At least some of the tubes must have lain exposed on the bottom for a long time. Their inner and outer walls were overgrown by sponge or tunnelled by worms and burrowing molluscs including *Hiatella.*

In 1958 I fished similar but for the most part thinner and narrower tubes (Table 1) from 40 metres on sand-clay bottom in Northumberland Strait (N. Lat. 46°03′; W. Long. 60°24′) off Murray Harbour, Prince Edward Island. These showed more rustiness and some evidence of secondary superficial deposits and they effervesced under acid. These tubes were taken while fishing for ocean quahaugs. (*Arctica islandica* Linné) with a hydraulic dredge which was set to dig in to a depth of 15 centimetres. Sea scallops were occasionally taken in the hauls.

In 1960, and several times since then, my colleague, Dr. Neil Bourne, has brought me tubes from the mixed mud, clay and rock bottom of the Mascarene

TABLE 1. — Description of clay tubes from three sources.

| Specimen no. | Length | Outside diameter | Inside diameter (bore) | Thickness of walls | Further description |
|---|---|---|---|---|---|
| | mm | mm | mm | mm | |
| Penobscot Bay | | | | | |
| 1. No dimensions available | | | | | Photographed in Fig. 1 but broken since. |
| 2. | 187 | 63 — 69 | 37 — 39 | 11 — 18 | Branched; axis of each branch inflected 45° from that of the main tube; branches broken off at fork; bore of 1st branch 39—43 mm, of 2nd branch 40—45; main tube straight; bore uniform |
| 3A. | 114 | 55 — 61 | 34 — 36 | 12 — 14 | Unbranched; straight; bore uniform |
| 3B. | 95 | 70 — 82 | 41 — 45 | 9 — 20 | " |
| 4. | 127 | 53 — 59 | 30 — 35 | — | " |
| 5. | 128 | 54 — 91 | 34 — 36 | — | Unbranched; straight; bore flares at one end |
| 6. | 233 | 42 — 103 | 25 — 49 | — | " |
| 7. | 261 | 35 — 82 | 22 — 49 | — | Unbranched; straight; bore tapers gently toward one end |
| Northumberland Strait | | | | | |
| 8. | 72 | 55 — 61 | 20 — 33 | 8 — 21 | Unbranched; straight; uniform bore; much rusty deposit throughout; effervesced with acid |
| 9. | 128 | 35 — 45 | — | — | Unbranched; straight; bore uniform; sponge growing from one end |
| Passamaquoddy Bay | | | | | |
| 10. | 150 | 92 | 35 — 41 | 12 — 25 | Branched; larger branch broken off and opening almost sealed off; small branch bore 27 mm inflected 20° to main axis; main tube straight |
| 11. | 122 | 83 | 35 — 40 | 11 — 25 | Inside wall shows a sealed-off branch 30 mm wide, 15 mm long and inflected 45° from axis of main tube; main tube curved 45° opposite branch; bore smaller beyond branch |
| 12. | 116 | 85 | 33 | 18 — 30 | Unbranched; straight; bore uniform; massive walls |
| 13. | 164 | 83 | 38 — 52 | 11 — 18 | Unbranched; curved 10° from straight; bore flares toward one end |
| 14. | 85 | 80 | 43 — 57 | 10 — 21 | Branched (?); only one wall (78 mm long) of possible branch present; inflected 90° from axis of main tube; main tube straight; bore flares at branched end |
| 15. | 90 | 73 — 82 | 35 — 42 | 11 — 26 | Unbranched; straight; bore uniform |

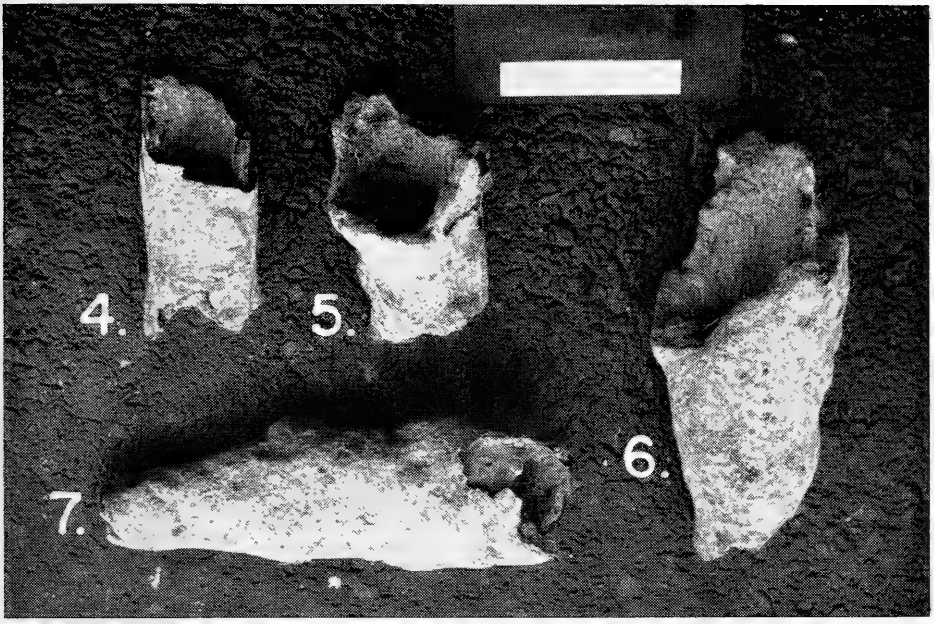


FIGURE 2. Penobscot Bay tubes in collection of Boothbay Harbor Laboratory of the Maine Sea and Shore Fisheries Department. No. 4 a straight thin-walled tube with angularly broken ends and uniform bore. In Nos. 5 and 6 the bore flares suddenly. In No. 7 it tapers gently.

scallop bed (N. Lat. 49°04-05′; W. Long. 46°56′) in Passamaquoddy Bay. These (Table 1) closely resemble the tubes found in Penobscot Bay.

Recently Mr. Phillip Goggins of the Maine Department of Sea and Shore Fisheries provided measurements of the four Penobscot Bay tubes shown in Figure 2 and described as Nos. 4 to 7 in the Table. One of these (No. 7) is peculiar in its gently tapered form but in both size and form the other three are like those I collected there thirteen years ago.

Capt. Wooster told me that when he first fished scallops in Penobscot Bay he used to find clay tubes up to two feet long and not infrequently branched. He thought the small sections we found were parts of longer tubes that had been broken by fishermen constantly dragging scallop gear over the bottom. He took this as evidence that tubes are not being formed now or are being formed at a very slow rate.

## WHAT ARE THEY?

The similarity of the clay tubes taken from these three widely spaced Atlantic inshore areas suggests that they have similar origins. But what are they? I have had them examined by many palaeontologists and zoologists. None have seen anything quite like them and none know what they are. However, we have some interesting speculations.

*Non-organic theory*

Dr. Madelein A. Fritz and her colleagues at the Royal Ontario Museum of Palaeontology, Toronto, suggested that the tubes may have been formed by some purely physical agency, that the problem may be one of sedimentation and that the tubes may not be fossils even in the wide sense of the term.

*Organic theories*

However, most of my consultants take the view that while they are not the remains of plant or animal bodies, they are probably formed in association with living and/or dead organisms. The two most popular theories are that they are:

(1) Encrustations formed around branches of trees that have fallen into the water.

(2) Solidified walls of tunnels of burrowing animals.

*Branch-encrustation theory*

This was the theory held by Capt. Wooster of Camden. He reasoned that "something" deposited a layer of clay around branches that had fallen into the water and that shipworms ate out the wood leaving the tubes. Dr. A. G. Huntsman, Professor Emeritis of Marine Biology, University of Toronto, and Dr. E. L. Bousfield of the National Museum of Canada, Ottawa, and several others have also proposed the encrustation theory, suggesting that they are subconcretions in glacial outwashes of the Wisconsin period. Casts of the inner walls do show irregularities that resemble the bark of trees. Others have suggested that coralline algae were the encrusters. But their depositions are limey and effervesce vigorously under acid and none of the tubes effervesced under acid except those from Northumberland Strait which seemed to carry secondary deposits.

Some have objected to the branch encrustation theory because branches with encrustations like clay tubes in process of formation are not found in fresh or salt water and because vestiges of wood have never been found in the tubes. Another objection is that the inside diameters of branches of forked tubes (Dr. Bourne found several branched specimens in Passamaquoddy Bay) are sometimes as great and sometimes greater than the inside diameter of the main stem below the fork. Whereas, in tree branches, the sum of the squares of the diameters of the branches is approximately equal to the square of the diameter of the main stem.

*Walls-of-tunnels theory*

Several of my consultants are proponents of this theory and reason (1) that secretions of burrowing animals could consolidate the walls of their tunnels thus producing long or short tubes depending on the habits of the animal; (2) that fishing gear could occasionally dig into the bottom or snag exposed ends of tubes breaking off pieces and (3) that these may be caught immediately in the gear as clean tubes or may lie on the surface attracting epiphytic growths or mineral depositions before they are finally fished up.

The walls-of-tunnels theory readily accounts for the shortness and emptiness (no wood) of the tubes. If the animals possibly responsible were in the habit of making branching tunnels this would account for observed cases of uniformity of the inside diameters of the main tube and its forks (Figure 1 and

No. 2 in Table I). If animals of different sizes used a common entrance to their burrows this would account for differences in the bore of main and branch tubes. If the animal's body tapered it could account for tapering of the tube shown in Figure 2 (No. 7 in Table I). It may have been the end of a blind tunnel. Furthermore, it could account for the one flaring end (tunnel entrance) of some tubes. This, however, could be equally well explained by the branch-encrustation theory. The flare could be the remnant of a deposit about the base of a branch where it joined a main stem.

An objection to the tunnel theory is that although several animals are known to burrow, none is certainly known to form clay tubes. Perhaps this is because tube formation requires rare and special bottom conditions or because these animals have been too little studied.

Conceivably wrymouths (*Cryptacanthodes maculatus* Storer, Wiley and Huntsman, 1921) or eels (*Anguilla rostrata* (Le Sueur) Bigelow and Schroeder, 1953) could be responsible. Both these fish are burrowers in soft soils (not firm clay) and the ranges of both comprehend the three areas where tubes have been found (Bigelow and Schroeder, 1953). A colleague, Dr. David Scarratt, has suggested that a crustacean such as *Chaetopterus* may be the tube maker but their burrows are likely to be much narrower.

Dr. Leo G. Hertlein, Associate Curator of collections in the Department of Geology of the California Academy of Sciences states that most of his associates favour the walls-of-tunnels theory. One of them thinks that a crustacean may be responsible but most of them say "Eels". One, who has fished eels in Japan, holds strongly to this opinion.

## QUESTION OPEN

I am grateful to Mr. Goggins and others who have helped me with collections, to those who have been kind enough to examine them and to Dr. Bousfield who prepared a cast of one of the tubes and criticized the manuscript of this report. The comments received have been stimulating but so far have not solved the riddle of clay tubes. What are they? I would welcome suggestions or evidence.

## SUMMARY

Sections of clay-like tubes up to 260 millimetres long and with outside and inside diameters of about 70 and 40 millimetres have been taken from sea scallop grounds 20 to 80 metres deep in Penobscot Bay, Passamaquoddy Bay and Northumberland Strait. Fishermen, zoologists and palaeontologists have not identified them but theorize that they are encrustations formed around branches of trees or solidified walls of tunnels of burrowing animals.

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# DISTRIBUTION OF RUE-ANEMONE AND ITS NORTHERN LIMIT IN CANADA

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University of Toronto, Toronto

The rue-anemone is a delicate and attractive spring wildflower, common and well-known in the eastern United States but of limited occurrence in Canada. Its white, often pink-tinged, flowers suggest a small anemone but the arrangement of the flowers on the stem and the shape of its leaves have lead botanists to place it in a genus by itself and it appears as *Anemonella thalictroides* (L.) Spach in our manuals. The anatomical structure of its achenes, however, is so like that in the meadow-rues (*Thalictrum*) that recent authors have transferred it to that group, as *Thalictrum thalictroides* (L.) Eames & Boivin (Boivin, 1957).

The over-all distribution of rue-anemone is shown in Figure 1. This map is based on records published in standard floras (Almon, 1930; Deam, 1940; Jones & Fuller, 1955), on data kindly supplied by curators of several State herbaria, on specimens examined in the Gray Herbarium and the herbarium of the New England Botanical Club at Harvard University, and on specimens seen in eight Canadian herbaria. The range of the species may be stated as extending from southernmost Maine and New Hampshire, southward to Georgia and westward to eastern Minnesota, Iowa, Kansas and Oklahoma.

The occurrence of the plant in a portion of its northern range is shown in more detail in Figure 2. All the stations indicated on this map, except three, are confined to the area south of the line A-B which represents the northern boundary of the Carolinian Zone as defined by Fox and Soper (1955) based upon the limit of certain trees and shrubs of southern affinity which are restricted to this portion of Ontario. The position of the line is further supported by the ranges of other species subsequently plotted by Soper (1956, 1962). The three exceptions mentioned are the occurrences of rue-anemone in the valley of the Grand River in Waterloo County (W), at Snelgrove near the foot of the Niagara Escarpment in Peel County (P), and at a group of contiguous stations in southern Leeds County (L). The first two may represent occurrences in habitats climatically or otherwise favourable and present no problem, but the latter in the upper St. Lawrence valley deserves fuller comment.

The presence of the plant in Leeds County has only recently become known but its finding there reveals a pattern of distribution which is distinct, conforming to that shown by some other species of Carolinian affinity having a main area of concentration in southern Ontario west of Lake Ontario and a lesser, apparently disjunct, area of occurrence east of Lake Ontario. The other

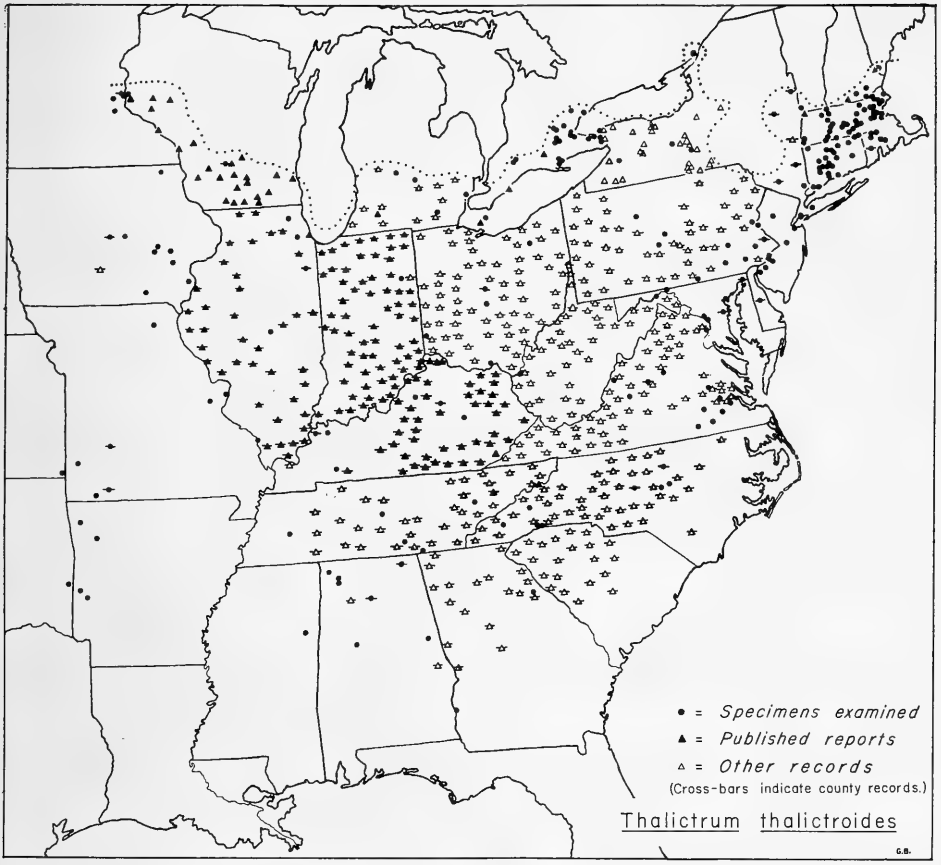


FIGURE 1. Distribution of *Thalictrum thalictroides* in North America. The dotted line approximates the northern limit.

species include such plants as *Allium canadense*, *Corylus americana*, *Jeffersonia diphylla*, *Lespedeza hirta*, *L. intermedia*, *Podophyllum peltatum*, *Quercus muehlenbergii*, *Rhus copallina*, *Taenidia integerrima* and *Vaccinium stamineum*.

The first suspicion that *Thalictrum thalictroides* might occur in eastern Ontario came from a report in 1951 by George W. North of Hamilton, a student at the University of Toronto, who claimed to have seen the plant but was unable to supply definite information as to location. In 1961, one of the authors, while extending his floristic studies of the upper St. Lawrence valley (Dore, 1961) to Leeds County, encountered the plant anew and charted its occurrence in some detail. Around the hamlet of Mallorytown Landing rue-anemone was found growing in abundance at a number of sites all within an area about three miles long and half a mile wide on the granitic ridge which parallels the shore of the St. Lawrence at this point. It grew in dry, more-or-less open, woodland characterized by large trees of *Pinus rigida*, *P. strobus*, *Quercus alba*, *Q. borealis* var. *maxima*, *Carya ovata*, *C. cordiformis*, *Acer*

*saccharum*, *A. rubrum* and *Juniperus virginiana*. It was particularly prevalent along the unkept margins of an old roadway along the ridge where long-time freedom from grading, grazing, and spraying with herbicides undoubtedly accounted for its survival. It had been eliminated from the cleared and cultivated lands adjoining but persisted in rocky or wooded pastureland which had never been excessively grazed. But at several likely sites only a mile or two distant from the ridge, the plant could not be found. It was evident from field inspection that it was quite localized in this part of Leeds County.

This finding brings up the matter as to whether the rue-anemone on the Mallorytown Landing ridge is further isolated, i.e. disjunct by a distance of some eighty-five miles, from the nearest known station in New York state, or whether its presence just represents the terminus of a northern lobe of continuous distribution as tentatively outlined in Figure 1. The northern portion of New York state is not too well known botanically and we cannot state definitely whether the species is present, or is absent, there. Consideration should therefore be given to the various causes that might be responsible for isolated or restricted occurrence so that this matter may be appraised by critical field observation at some opportune time in the future. These causes would include: 1. local introduction; 2. habitat preference; 3. physiographic isolation; 4. aboriginal transport.

1. Considering the extent of the stands, their position relative to farm buildings and gardens, the nature of the habitat and the association of other native species, it was obvious that the rue-anemone could not have been introduced to the area at any time in the hundred or so years since settlement — it had been there since prehistoric times.

2. Ecologically, there was nothing unique or particularly favourable about the habitat that would seem to explain why rue-anemone would establish and persist only on the Mallorytown Landing ridge. There are many sites with similarly rich, warm, well-drained soil on igneous (as well as calcareous) outcrops throughout the Frontenac Axis and the surrounding portion of Ontario where it is not known to grow. The plants on the ridge, in flowering profusely, producing achenes and full clusters of tubers, showed none of the restrictive growth-effects often associated with species persisting under extreme conditions as at the climatic limit of range. The problem is rather to explain why rue-anemone did not spread farther northward in its post-glacial migration.

3. Rue-anemone might be considered a slow-migrating species. Its stems are low and its few achenes are in no way modified for long distance dispersal by wind, water or animals; it might spread a few feet per year at the best. Physical barriers in terrain would retard its migration accordingly. There was some evidence that the land surrounding the ridge, up to an elevation of about 275 or 300 feet, had been inundated at an earlier date, perhaps during some high-level stage of the St. Lawrence (present level 245 feet) or a water-body that preceded it. Signs of submergence were present in the form of sandy deposits along the base of the ridge, limestone cliffs apparently undercut by waves at the geological contact about three miles away, and a complex of sorted

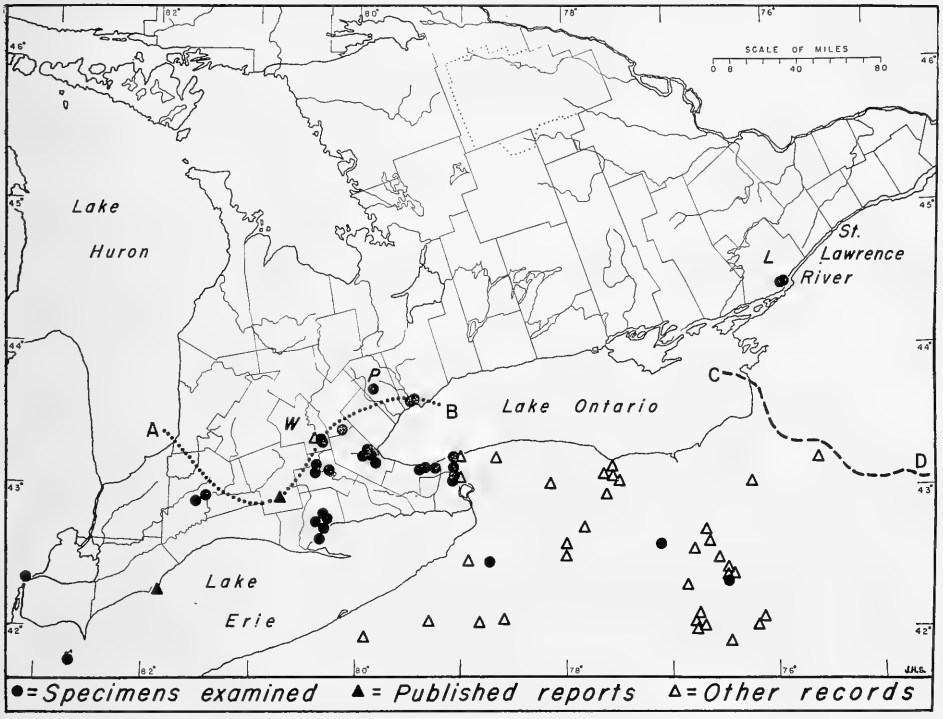


FIGURE 2. Distribution of *Thalictrum thalictroides* in Southern Ontario and adjacent regions. A-B is a proposed northern limit for the Carolinian Zone, C-D a similar boundary estimated for New York State. The letters L, P, and W indicate the locations of the counties of Leeds, Peel and Waterloo referred to in the text.

gravel, bedded sand, silt and varved clay laid down in layers or lenses as exposed in a large pit in the valley along the north of the ridge; the granite of the ridge itself was smoothed by glacial action and the soil on it may be till. The physiographic history of the area is undoubtedly complex but, if the sequence of events could be worked out, it might be revealed that, at first, substantial waters flowed through the plain north of the ridge and then, later, switched their course or entrenched themselves in the present channel of the St. Lawrence south of the ridge. Isostatic uplift, greatest to the north in post-glacial times could have been the cause of change in water level. Some such scheme of events might have arrested the northward migration of rue-anemone, or caused its local isolation through elimination from surrounding lowland. In any case, it should occur over a considerable part of northern New York State, much of which is above the level of submergence.

4. Transport by the aborigines is another explanation which should be given consideration because it is a way, not fully appreciated, in which disrupted plant distribution can come about. The St. Lawrence has always been an important travel and trade route for the Indians and artifacts from several cul-

tures, from early Laurentian to late Iroquoian, have been discovered at numerous sites along its shores. A concentration of these sites is known within a few miles of Mallorytown Landing (Stevens, 1961), which might be expected, for it is here that the islands of the Thousand Islands Archipelago first start to crowd the channel of the great river, offering shelter for canoe flotillas but allowing an unobstructed view downstream. Perhaps, then, it is more than just chance that rue-anemone should occur here and not again until the Oneida country of the Mohawk valley. The plant's shallow tubers would be easy to harvest and transport, and they look as though they would be very good to eat, either cooked or raw, which feature, however, is not mentioned in works on ethnobotany (Yanovsky, 1936). Several other plants, such as the oaks, hickories, hazelnuts, butternut and walnut, the wild onion, may-apple, pokeberry, monarda and snakeroot, could have been brought to the locality for the same or other useful purpose; but there are also present the pitch pine, blue-stem grasses, tick trefoils, lespedeza, certain asters and goldenrods all of which are plants of southern affinity not likely to be transported in this way. We are inclined, therefore, to disregard for the present the possibility of local aboriginal introduction and give fuller weight to the explanation that rue-anemone occurs in southern Leeds County as the result of natural spread and represents there the tip of a lobe of continuous distribution extending northward through the lowland gap between the eastern end of Lake Ontario and the Adirondacks. In this respect it conforms with the post-glacial migration pattern of numerous other species of Carolinian affinity.

Since *Thalictrum thalictroides* is a comparatively rare plant in Canada, it seems appropriate to cite the full data for the Canadian specimens as plotted in Figure 2 (herbaria abbreviated according to *Index Herbariorum* 1959). BRANT Co.: lot 11, conc. IV, Brantford Tp., 18 May 1947, *W. H. Minshall 3887* (DAO); Brantford, 24 May 1928, *O. Stewart* (QUK); Paris [without date], *Dr. Kemp* (QUK). ESSEX Co.: Pelee Island, 15 June 1882, *J. Macoun* (TRT). LEEDS Co.: granitic talus, Mallorytown Landing, 27 June 1961, *W. G. Dore 19101* (DAO); 0.25 miles WNW of Mallorytown Landing, 23 May 1962, *Dore & Sherk 19906* (DAO, TRT); 2 miles E of Mallorytown, 4 June 1962, *Koyama & Dore 13121* (DAO, TRT). LINCOLN Co.: Queenston Heights, 13 Aug. 1896, *Wm. Scott* (CAN, DAO, TRT); St. Catharines, May 1929, *W. W. Judd* (WWJ private herb.); Two-Mile Creek near Niagara-on-the-Lake, 30 May 1951, *J. H. Soper 5180* (TRT); Jordan Harbour, 17 May 1950, *Soper & Shields 4351* (TRT); Vineland, 10 July 1955, *K. Rielly* (MCM). MIDDLESEX Co.: Komoka, 1902-3, *A. Baker* (OAC); Caradoc, 25 May 1891, *ex herb. J. Dearness* (DAO). NORFOLK Co.: wooded ravine, Turkey Point, 31 May 1938, *J. H. Soper 845* (MCM); two miles NE of Walsh, 2 July 1958, *Maycock & Maryniak 1739* (MTMG); near Normandale, 22 May 1937, *T. M. C. Taylor* (TRT); Lynn Valley, 1 May 1951, *M. Landon* (MCM); west of Simcoe, 1 June 1889, *J. Dearness* (DAO). PEEL Co.: Snelgrove, 8 June 1911, *J. White* (TRT). WATERLOO Co.: Orr's Lake, west of Galt, 24 May 1939, *F. H. Montgomery 174* (DAO, OAC, MCM); Galt, May 1910, *W. Herriot* (DAO). WELLAND Co.: Niagara Glen, June 1952, *Ian Hamilton* (NPC); Niagara Falls, 7 June 1873,

*J. Macoun* (MT). WELLINGTON Co.: Puslinch, 27 May 1937, *J. J. Stroud* (TRT). WENTWORTH Co.: McMaster Ravine, Hamilton, 18 May 1937, *J. H. Soper 1141* (TRT); Albion Falls, 9 May 1937, *R. P. Burcher* (DAO); Cootes Paradise, 25 Apr. 1898, *F. P. Clappison* (TRT); Waterdown Road, 1889, *Morris & Alexander* (MCM). YORK Co.: Humber Valley, Swansea, 14 May 1939, *L. T. Owens* (TRT); Toronto, 8 May 1911, *J. White* (MT).

The authors wish to acknowledge the assistance of those who have provided maps or county lists: Stanley J. Smith (New York); Clara G. Weishaupt (Ohio); Edward G. Voss (Michigan); John M. Fogg, Jr. (Pennsylvania); Earl L. Core (West Virginia); A. B. Massey (Virginia & Kentucky); E. Lucy Braun (Kentucky); Wilbur H. Duncan (Georgia); Albert E. Radford (North & South Carolina); A. J. Sharp (Tennessee).

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Received for publication 25 March 1963

# SOME RARE PLANTS FROM THE MACKENZIE MOUNTAINS, MACKENZIE DISTRICT, N. W. T.

W. J. Cody

Plant Research Institute, Central Experimental Farm, Ottawa, Ontario

Among the most interesting but still poorly collected areas in Canada are the Mackenzie Mountains which form the divide between the Mackenzie and upper Yukon Rivers. The most important collections in this region are those of A. E. Porsild (1945, 1951) from along the Canol Road and H. M. Raup (1947) at Brintnell Lake. In addition a few minor collections which have been reported in several publications (Porsild, 1943; Cody, 1960, 1963; Jeffrey, 1961) have been made on the periphery of these mountain ranges.

Porsild (1961) published a report on a small collection from Hole-in-the-Wall Lake in the interior of the Mackenzie Mountains. Another small collection from the interior was made during the summer of 1962 by E. W. Johnson and D. Munro. This collection contains a number of interesting records which are reported below. The specimens are preserved in the Phanerogamic Herbarium of the Plant Research Institute, Canada Department of Agriculture (DAO). The numbers cited are those of the collectors.

The following information was furnished by Mr. Johnson: "The area from which the collection was made was within Lat. 62°30′ – 63°15′N and Long. 126°30′ – 127°05′W. This is a band running along the main Redstone River taking in some tributary streams and extending from Dal Lake southward to a point 8 miles south of Little Dal Lake (Plateau Lake). The width of the band varied up to 15 miles from the Redstone River. Altitudes covered range from 3000 to 7000 ft. Habitats ranged from river and stream beds and banks to swamps and lakes to open grassy slopes and timbered areas to talus slopes, alpine meadows and high rocky ledges.

"One thing we noticed in particular for the majority of specimens was the variety of habitats to which they were adapted. This gave rise to a large variation in size and flowering dates".

*Lychnis macrosperma* (Porsild) Raup: talus slopes, scarce, *39*.

Previously known in Mackenzie District from two collections by Wynne-Edwards at Bolstead Creek, Mile 111E Canol Road (Porsild, 1945; Raup, 1947). It is a rare species otherwise known only from eight collections in central and coastal Alaska (Hultén, 1941-52).

*Aquilegia brevistyla* Hook.: scarce, *24*.

Raup (1947) recorded this species from the Brintnell Lake area some 50 miles southwest of our area, but it is apparently otherwise unknown in the Mackenzie Mountains. Porsild (1951) noted it only as far north as Pelly River on the Yukon section of the Canol Road, but Raup (1947) stated that he had seen a specimen from Fort Good Hope in the Mackenzie River Valley and also a Richardson specimen from Great Bear Lake.

*Lesquerella arctica* (Wormsk.) Wats. *s.l.*: rare, *20*.

Raup (1947) cites only one collection from southwestern Mackenzie District: near mouth of North Nahanni R., *Wynne-Edwards*.

*Contribution No. 305 from the Plant Research Institute, Research Branch, Canada Department of Agriculture, Ottawa, Ontario.

*Parrya nudicaulis* (L.) Regel: frequent, *8* (petals rose-purple); *16* (petals white).

Known from several collections along the Canol Road (Porsild, 1945; Raup, 1947) but previously unrecorded from south of that road in the Mackenzie Mountains.

*Smelowskia borealis* (Greene) Drury & Rollins var. *borealis, Melandion boreale* Greene: *89*.

Porsild (1945) and Raup (1947) cite several collections from along the Canol Road on the east slope of the Mackenzie Mountains, but it is otherwise unknown from that chain of mountains.

*Saxifraga caespitosa* L. *s.l.*: *43*.

Apparently very rare; none of the races of *S. caespitosa* have been previously recorded from the Mackenzie Mountains in Mackenzie District; Porsild (1951), however, records ssp. *silenaeflora* (Sternb.) Hult. from high elevations at Mile 95 and Mile 132 Canol Road as new to the flora of Yukon Territory.

*Saxifraga cernua* L.: *53, 87*.

The only other record for the Mackenzie Mountains in Mackenzie District is a *Wynne-Edwards* collection from Bolstead Creek, Canol Road (Porsild, 1945; Raup 1947). Porsild (1951) lists several collections from along the Canol Road in the Yukon Territory.

*Saxifraga flagellaris* Willd. ssp. *flagellaris*: *69*.

Previously known from the Mackenzie Mountains of Mackenzie District from a single collection: Bolstead Creek, Canol Road, *Wynne-Edwards* (Porsild, 1945; Raup, 1947).

*Potentilla biflora* Willd.: scarce, *11, 57*.

Previously recorded from the Mackenzie Mountains in Mackenzie District only in high altitudes from Bolstead Creek and Plains of Abraham along the Canol Road (Porsild, 1945; Raup, 1947).

*Primula stricta* Hornem.: rare, *22, 29*.

Although Raup (1947) recorded this species from as far north along the Mackenzie River as 5 mi. above Old Fort Norman, he neither collected it nor saw any other specimens of this or any other species of *Primula* in the Mackenzie Mountains of Mackenzie District. Porsild (1951) recorded *P. stricta* only as far north as the Pelly River valley along the Yukon Territory portion of the Canol Road.

*Menyanthes trifoliata* L.: shallow ponds, abundant-scarce, *60*.

This is a lowland species which has been collected as far north as the delta of the Mackenzie River and the Eskimo Lake Basin (Porsild 1943) and along the Liard River (Cody, 1963), but has never been recorded from within the confines of the Mackenzie Mountains in Mackenzie District.

*Gentiana prostrata* Haenke: rocky ledge—high, rare, *34;* rocky soil—varied elevations, common, *49*.

The only other record of *G. prostrata* for Mackenzie District is that of Jeffrey (1961) from Nahanni Butte.

*Polemonium boreale* Adams: frequent, 7.

This is an arctic-alpine species which was previously known to extend southward in the Mackenzie Mountains of Mackenzie District only as far as Bolstead Creek on the Canol Road (Porsild, 1945; Raup, 1947).

*Mertensia eastwoodae* Macbr.: *1*.

Our specimen has sparsely appressed strigose pedicels; the lobes of the calyx are glabrous on the back but with strigose-ciliate margins; the leaves are pubescent on both sides; although quite disjunct from the western Alaskan range of *M. eastwoodae* given in Hultén (1941-52) it keys out there quite readily. *M. eastwoodae* has not previously been reported for Mackenzie District.

*Pinguicula vulgaris* L.: frequent, *26*.

Wynne-Edwards (Porsild, 1945; Raup, 1947) collected this plant in the Mackenzie Mountains at Bolstead Creek and Lone Mt. and Cody (1963) found it on the southeastern fringes of these mountains, but Raup strangely did not find it at Brintnell Lake.

*Erigeron compositus* Pursh: frequent, *38*.

The only collection cited by Raup (1947) for southwestern Mackenzie was a *Crickmay* specimen from the Liard River between Nahanni Butte and Simpson. This species is, however, known from Great Bear Lake and the Arctic Coast (Porsild, 1943) where I have also collected it, Indin Lake (Cody, 1956) and at McNallie Creek, Mile 23½, Enterprise–Mackenzie River Highway (Thieret, 1961).

*Erigeron hyssopifolius* Michx.: scarce, *19*.

Although known from the southern and eastern peripheries of the Mackenzie Mountains (Raup, 1947), *E. hyssopifolius* has not

previously been recorded from the interior of this mountainous area.

*Antennaria pulcherrima* (Hook.) Greene: scarce, *31*.

Previously known from Mt. Flett along the Liard (Cody, 1963) and from Lone Mt. near the mouth of the North Nahanni River (Porsild, 1945; Raup, 1947) but not from the interior of these mountain ranges.

*Senecio resedifolius* Less.: sparse—scarce, *88*.

Our plant is glabrous, with glabrous achenes and reddish-yellow ray florets and hence keys readily to this entity. In Mackenzie District, Porsild (1943) has recorded *S. resedifolius* from the Richardson Mountains and Porsild (1945) and Raup (1947) have recorded it from several stations along the Canol Road. The present collection extends the known range some 100 miles further south in the Mackenzie Mountains.

*Saussurea viscida* (Hult.) var. *yukonensis* (Porsild) Hult., *S. angustifolia* DC. var. *yukonensis* Porsild: sparse—frequent, *47*.

The type locality of this variety is Bolstead Creek on the Canol Road, the only other known locality in Mackenzie District. Hultén (1941-52) gives the range of var. *yukonensis* as Wrangel I. in Eastern Siberia, Alaska, Yukon, Northwest Territories [Mackenzie Mountains] and Canadian Rocky Mts.

*Chrysanthemum integrifolium* Richards.: *78*.

The only other collections of this species in the Mackenzie Mountains of Mackenzie District were made along the Canol Road at Bolstead Creek and Sekwi River (Porsild, 1945; Raup, 1947).

*Arnica frigida* Meyer, *A. louiseana* Farr ssp. *frigida* (Meyer) Maguire: scarce, *13*.

This is a western arctic species which occurs as far east as Coppermine on the Arctic Coast and Great Bear Lake. (Hultén, 1941-52). It is known from the Richardson Mountains and extends southward in the Mackenzie Mountains to the Liard Range and Nahanni Butte (Jeffrey, 1961). Porsild (1945) and Raup (1947) record *A. louiseana* ssp. *frigida* from Bolstead Creek on the Canol Road and Lone Mountain, but Raup did not find it at Brintnell Lake.

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# REVIEWS

**Beyond Your Doorstep**

By Hal Borland. Alfred A. Knopf, New York, 1962. 401 pp. $7.25.

Mr. Borland, who has written "nature editorials" for the New York Sunday Times since 1942, as well as complete nature books, poetry, novels, essays and other books, comes well equipped to reveal the nature and complexity of the world *Beyond Your Doorstep.*

Though his experience is country-wide, he has concentrated on the ecology of New England near his home in Massachusetts. He shows how a knowledge of species and their interactions there applies to the whole area of the northeastern United States and adjacent parts of Canada, and indeed—in a general way—to all of nature.

Mr. Borland begins indoors, introducing us to the flora and fauna of his country home as he himself explored it when he first moved to the house. Then he moves outside to the barns and surrounding land, along a rural road, through pasture, meadow, bog and swamp.

He discusses natural groupings of animals and plants, "ecosystems" and the effects of weather, physiography, geology and soils. He reviews edible and poisonous plants and presents a calendar of biological events through the year, a phenological story for his area.

A chapter is devoted to the naming of plants and animals, including the history of the methods used and the scientific names of all the species mentioned in the text. The concluding section, "An Armful of Books", lists, with helpful comments, useful references for further reading.

The pages are full of snatches of interesting information. Well chosen phrases bring countless facts and scenes to life before the reader's eyes—the marsh marigold, that is really a big buttercup that likes wet feet, red squirrels—hyperthyroid little bundles of indignation and energy—the brown silence of the deep woods.

Mr. Borland's powers of observation and description are exact. His tools for observation are a 10x lens, a binocular, his own eyes and patience. He recommends to others, the lens, binocular and curiosity. The lens, in fact, opens up a new world where a clover head is a whole bouquet of flowers and butterfly eggs may look like tiny carved gems.

Some will resent his frequent reference to birds and *animals*, rather than mammals, but will enjoy his description of why the harvest moon is a special phenomenon. His statement that lichens are absent from cities because of fumes can be refuted in Ottawa, but may well be true in the larger more industrialized cities of his experience. What errors or misconceptions there may be are but minor intrusions in a book that (in a delightful and graphic way) constantly provides the reader with new insights into the simple things of nature. Perhaps we too often take these for granted and the heightening of our perceptions cannot fail to enhance the pleasure and appreciation we feel when we view even the most usual scenes in nature.

All naturalists will echo his final statements, "But even the best books and magazines are essentially no more than a table of contents for the vast volume of material that awaits anyone in the dooryard or just beyond. The big definitive book about nature is nature herself".

The book is nicely produced with easily legible type, attractive small drawings, excellent short chapter abstracts and a refreshing absence of typographical errors. Naturalists of all types will find in it both the familiar and the new—all attractively presented.

Canadian Wildlife Service
Ottawa, Ontario

V. E. F. Solman

**Rascal: A Memoir of a Better Era**

By STERLING NORTH. E. P. Dutton & Co., New York. 1963. 189 pp. *Illustrations by* John Schoenherr. $4.50.

"He was the only baby raccoon I have ever held in my hands. And as he nestled upward like a quail chick and nuzzled like a puppy seeking its mother's milk, I was both overwhelmed with the ecstasy of ownership and frightened by the enormous responsibility we had assumed."

These lines, in the author's "memoir" of his youth in southern Wisconsin, introduce us to Rascal. The book spans a single year, from May 1918 when the writer, age eleven, discovered the raccoon he was to observe so closely, to April the following year when Rascal relinquished his human friend's companionship in response to the lure of a mate. Around his story of the growth and learning of his pet, Mr. North has woven a vivid and warm picture of his boyhood, his family, the countryside and the era.

Artist John Schoenherr has not merely illustrated the text but has captured its spirit with his delightful sketches.

This volume is the first winner of the Dutton Animal Book Award—may the publishers have the good fortune of maintaining the standard Mr. North has set for it.

FRANCIS R. COOK

**Fishes of Ontario**

By H. H. MACKAY, Ontario Department of Lands and Forests. Bryant Press Ltd., Toronto. 1963. 300 pp., 26 col. pl., 4 halftone pl. $2.50.

This hand-sized green bound book with its fine layout and elegant typography is pleasing to read and to hold. The volume is embellished with colored plates by E. B. S. Logier.

Twenty-eight of Ontario's freshwater *sport fishes* are treated, a fact which might be more clearly indicated by the title. Several pages are devoted to each species under such headings as distribution, habitat, habits, food and growth, game qualities and record fish, economic value, management and further notes on research. Much intriguing and useful information has been harvested from some 200 references as well as from Dr. MacKay's wide experience. The text is spiced with text figures and clear graphs and tables. There are also sections on postglacial dispersal of fishes, conservation and management. A glossary and list of references complete the book.

The book is one of those few which would grace the shelf of the angler as well as that of the ichthyologist. The book should enhance Ontario's sport fishing to the tourist.

D. E. MCALLISTER

National Museum of Canada
Ottawa, Ontario

**Symposium on Marine Microbiology**

CARL A. OPPENHEIMER, Editor. Charles C. Thomas, Springfield, Illinois. 1963. 769 pages. $27.00.

This large volume shows very well the considerable progress that has been made in marine bacteriology since the subject began to be seriously studied about thirty years ago. It is thus a valuable book for reference. The symposium, from which came the sixty-six papers with eighty-eight authors (seven from Canada), was held in 1961, and, it is stated, did "much to take an inventory of what is known and to delineate many of the unsolved problems". The articles vary greatly from those of a general nature to reports of particular investigations. One wonders what "microbiology" means, as Part 3 makes it very broad with the title "Ecology of Algae, Protozoa, Fungi and Viruses" and but one paper on bacteria, while Part 5 on "Distribution and Function of Marine Bacteria" includes one paper on marine microbiology and another on phytoplankton among fourteen papers. No one should expect to get

from this book an adequate idea of what is known about the minute marine plants and animals that delighted the early naturalists who used the microscope. But there is information on attempts to discover in the sea the smallest organisms that multiply whether they be called plants or animals. Bacterial phages (viruses) have been found, and water filtered to remove anything as large as a tenth of a micron assimilates carbon, pointing to the presence of plants which produce rather than consume food.

A. G. HUNTSMAN

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Toronto, Ontario

OTHER NEW TITLES

**The Developmental Anatomy of Isoetes.** By DOMINICK J. PAOLILLO, JR. University of Illinois Press, Urbana (Illinois Biological Monographs 31). 1963. 130 pp. $2.50.

**A Guide to the Birds of Sussex.** By G. DES FORGES and D. D. HARBER. Oliver and Boyd, London. 1963. 177 pp. 30 s.

**Drawings of British Plants. Part XVIII Composite (4).** By STELLA ROSS-CRAIG. G. Bell and Sons Ltd., London. 1963. 41 plates. 10 s. 6 d.

**Use of Aerial Surveys by the Canadian Wildlife Service.** By DENIS A. BENSON. Queens Printer, Ottawa (Canadian Wildlife Service Occasional Papers No. 3). 1963. 40 pp.

Longmans Paperback Division, 20 Cranfield Road, Toronto 16, Ontario, has available the following *Apollo Editions* of interest to the naturalist.

**(A-7) The Insect World of J. Henri Fabre.** Edited by EDWIN WAY TEALE. 1949. 333 pp. $2.35.

**(A-15) Insects: Their Secret World.** By EVELYN CHEESMAN. 1952. 246 pp. $1.95.

**(A-21) Adventures in Nature.** By EDWIN WAY TEALE. 1959. 304 pp. $2.35.

**(A-25) A Multitude of Living Things.** By LORUS J. and MARGERY MILNE. 1947. 278 pp. $2.35.

**(A-26) The Twelve Seasons.** By JOSEPH WOOD KRUTCH. 1949. 188 pp. $1.85.

**(A-51) The Plant in My Window: An Adventure of the Spirit.** By ROSS PARMENTER. 1949. 148 pp.

## A Note on the Production of the Journal

The *Canadian Field-Naturalist* conforms to recommendation on the layout of periodicals issued by the International Organization for Standardization. It is set by linotype in Janson. The title is Kennerley. Boldface headings are Bodoni. Coverstock is 'Mayfair' by Howard Smith and text paper is Provincial Paper 'Thriftcoat'. The journal is printed by The Runge Press Limited, Ottawa, Ontario.

# NOTES

## Fish Remains From a 600-year-old Yukon Archaeological Site

Study of fish remains from archaeological sites provides a record of past fish distribution as well as reflecting on the food habits of the former inhabitants. The material here reported on was collected by Dr. R. S. MacNeish on a National Museum of Canada study. The fish bones were in Bennett Lake cultural phase deposits at the Little Arm site, Kluane Lake, southwest Yukon, 60° 06′ N., 135° 51′ W. Kluane Lake flows into the Donjek River, a tributary of the Yukon. Carbon dating places the sites at 1000-1800 A.D. Dr. MacNeish has prepared a manuscript on the archaeology of the sites which will probably be published in the Bulletin of the National Museum of Canada and in the R. S. Peabody Foundation Papers.

Three species are represented in the material. An incomplete right dentary, 50 mm long, bearing one tooth is identifiable as the northern pike, *Esox lucius*. A left posttemporal, 40 mm long is identifiable with a fairly high degree of certainty as belonging to a lake charr, *Salvelinus namaycush*. A 83 mm long right cleithrum is clearly from a burbot, *Lota lota*. These specimens are catalogued under number NMC63-123-S of the National Museum fish collection.

All of the species are currently known in the same general area (McPhail and Lindsey, 1958. Preliminary List of Fish Collections in the Institute of Fisheries, from Alaska, Yukon River, and Gulf of Alaska Drainages. Institute of Fisheries, University of British Columbia. Mimeographed, 8 pp.).

Drs. J. D. McPhail and S. U. Quadri assisted with identifications.

D. E. McAllister

National Museum of Canada
Ottawa, Ontario
3 September 1963

## A Spring Record of the White-throated Sparrow at Vancouver, B.C.

The White-throated Sparrow, *Zonotrichia albicollis*, is a rare migrant in the Vancouver area.

J. A. Munro and I. McT. Cowan in *Review of the Bird Fauna of British Columbia* list one record for Vancouver and three for Sannich, Vancouver Island. All of these records are for the fall months.

On May 15, 1962, at my banding station, I trapped and banded an adult White-throated Sparrow. This bird was last seen May 21, 1962. During this period it was retrapped six times. Identification was confirmed by Dr. Miklos D. F. Udvardy of the Department of Zoology, University of British Columbia. As far as I can ascertain, this is the first spring record for the lower mainland of British Columbia.

Dorothy M. Bradley

1848 Mathers Avenue
West Vancouver, B.C.
25 January 1963

# INDEX TO VOLUME 77

Compiled by Mrs. G. R. Hanes

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## ANNUAL MEETING

The eighty-fifth annual meeting of the Ottawa Field-Naturalists' Club will be held Tuesday, December 3, 1963, at 8.15 p.m., in the auditorium of the National Museum of Canada.